



Integrated Assessment of the impact of Aqueous Contaminant Stressors on Surface Water Ecosystems

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Published in:
Science for the environment - Environment for society

Publication date:
2011

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
McKnight, U. S., Rasmussen, J. J., Kronvang, B., Bjerg, P. L., & Binning, P. J. (2011). Integrated Assessment of the impact of Aqueous Contaminant Stressors on Surface Water Ecosystems. In *Science for the environment - Environment for society: Abstract book* Aarhus University.
http://www.dmu.dk/fileadmin/Resources/DMU/Nyt/Arrangementer/2011/abstractbook_netversion_01.pdf

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SCIENCE FOR THE ENVIRONMENT – ENVIRONMENT FOR SOCIETY

Bridging the gap between scientists
and practitioners in environmental science

5th-6th October 2011

SCIENCE FOR THE ENVIRONMENT

– ENVIRONMENT FOR SOCIETY

**Bridging the gap between scientists
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OCTOBER 5TH

09:00-10:00 Registration and coffee

10:00-11:00	Opening session – Auditorium 1 'Per Kirkeby' Lauritz B. Holm Nielsen , Rector Aarhus University Lea Kauppi , Chairman of PEER, Director of Finnish Environment Institute Marianne Thyrring , Permanent Secretary, Danish Ministry of the Environment Ronan Uhel , Department Head, European Environment Agency Practical information
11:00-12:00	Plenary session Roger Owen (Invited speaker): Experience from implementing the Water Framework Directive 1 Stefano Galmarini (Invited speaker): Air quality in Europe – what are the challenges for science and management.
12:00	Lunch
13:00-14:30	Plenary session Doug Evans (Invited speaker): Science based nature conservation in Europe: Lessons from the Habitats Directive 2 Bill Sutherland (Invited speaker): Biodiversity in an uncertain future - the role of predictive conservation ecology. Andrew Sharpley (Invited speaker): Phosphorus management in agricultural systems. 3
14:30	Coffee break

	Contributed session	Special session	Special session	Special session
15:00	Auditorium 1 'Per Kirkeby' Topic 1 Directives Chair: Poul Nordemann Jensen Lars Rudfeld (Danish Ministry of the Environment): Management Planning System for Natura 2000 sites 4 Lise-Samsøe Petersen (Danish Ministry of the Environment): Challenges in developing pesticide indicators and setting targets 5 Henrik Josefsson : The Water Framework Directive – A Directive for the Twenty-first Century? 6 Sandra Poikane : Are we measuring what we need to measure? The ecological assessment for management of European marine and fresh waters 7 Ilona Bärlund : Ten years of WFD implementation in Europe: a critical review based on the experience made in Germany 8	Auditorium 2 'Merete Barker' Links between biodiversity and soil ecosystem services Chair: Anne Winding Anne Winding : Ecological Function and Biodiversity Indicators in European Soils 9A Paul Henning Krogh : Ecological properties of earthworm burrows in an organically managed grass-clover system 9B Stefan Geisen : Identification, functional roles and ecosystem services of protozoa in soil 9C Anne Winding : Impact of functional microbial diversity on soil ecosystem services and assessment thereof 9D Mette Termansen : Economic Analysis of Conservation in Soil Biodiversity and Ecosystem Services 9E	Auditorium 3 'Eduard Biermann' Green energy policies. Chair: Daniela Perrotti Daniela Perrotti : The main scientific challenge for the session, and the European legislation context 10A Stanislas Herion : The French national and regional context: Region Centre – Vallée de la Beauce 10B Daniela Perrotti : The Italian national and regional context: Regione Puglia – Parco Nazionale dell'Alta Murgia; Regione Lombardia – Regione Rurale Padana 10C Marina Frolova : The Spanish example: Comunidad Autónoma de Andalucía – Alpujarra et Valle de Lecrín; Comunidad Autónoma de Castilla y León – Comarca de "La Mudarra" 10D	Auditorium 4 'Jeppe Vontilius' AQUARIUS Chair: Irene Wiborg Irene Wiborg, Anne Mette Sørensen, Langvad, Anna Hanson and Trine Balskilde Støttenborg : Bridging the gaps between science, regulation and practice in water environment management 11
16:45-18:15	Poster session + drinks P38-65			
19:00-19:30	Arrival and drinks Turbinehallerne			
19:30-01:00	Dinner Turbinehallerne			

OCTOBER 6TH

08:00-09:00 Registration

Auditorium 2
'Merete Barker'

Auditorium 3
'Eduard Biermann'

Auditorium 4
'Jeppe Vontillius'

	Contributed session	Special session	Contributed session
09:00	<p>Topic 2: Biodiversity Chair: Flemming Skov</p> <p>Atte Moilanen (Invited speaker): Disentangling the complexity of biodiversity using ecoinformatics</p> <p>Carsten Nesshöver (Invited speaker): Improving the science-policy on biodiversity and ecosystem services: a major challenge for the environmental science and policy 12</p> <p>Henrik Enghoff: The blurred baseline: Denmark's unknown biodiversity 13</p> <p>Gerd Lupp: Land Use Management, Ecosystem Services and Biodiversity - Developing Regulatory Measures for Sustainable Energy Crop Production (LÖBESTEIN) 14</p> <p>Toke Thomas Høye: Evaluating and communicating simulated wildlife responses to land-use scenarios 15</p>	<p>Climate models: Uncertainties, effects and adaptation Chair: Jens Christian Refsgaard</p> <p>Jens Christian Refsgaard: Climate change adaptation strategies: Water management options under high uncertainty - A Danish example 16A</p> <p>Jay S. Gregg: Development of Decision Support Matrices for Climate Change Adaptation Planning 16B</p> <p>Jørgen E. Olesen: Uncertainties in assessing climate change impacts and adaptation in agriculture 16C</p> <p>Manuel Montesino: Uncertainties in Agriculture Impact Studies under Climate Change 16D</p>	<p>Topic 4: Management tools Chair: Nikolai Friberg</p> <p>Brian Kronvang (invited speaker): A hindcast and forecast of catchment management strategies and outcomes for nutrients in Denmark</p> <p>Franscisca Neumann: Harmonized modelling of nutrient emissions into and loads in European river systems 17</p> <p>Line Block Hansen: Environmental and economic effects of regulating phosphorus use and losses from the agricultural sector – an empiric study 18</p> <p>Laura O. Petrov: Scientists and Stakeholders working together on land use modelling at the regional scale: an input to urban sustainable indicators for Europe 19</p> <p>Andrew J. Wright: The science-policy disconnect: language issues at the science-policy boundary 20</p>
10:40 Coffee break			
	Special session	Contributed session	Contributed session
11:10	<p>Science-based nature management Chair: Morten Tune Strandberg</p> <p>Morten Tune Strandberg: Management of Danish inland wet heathland 21A</p> <p>Knud Erik Nielsen: Is current management of semi-natural ecosystems short-sighted and limited, rather than science based and having a long sight? 21B</p>	<p>Topic 3: Low impact – low carbon Chair: Lise Marie Frohn</p> <p>Simone Bastianoni (Invited speaker): Environmental sustainability in Europe from an ecosystems perspective - research status and scientific challenges</p> <p>Torben Sigsgaard (Invited speaker): Health effects from air pollution – research status and scientific challenges</p>	<p>Topic 4: Management tools II Chair: Brian Kronvang</p> <p>Anthony Fox: Biodiversity over the horizon: modelling the distribution and abundance of marine waterbirds in the Inner Danish Waters 25</p> <p>Stefan Heinänen: Useful tools for assessing conservation targets and impacts on marine habitats – examples of waterbird populations and marine infrastructures 26</p>

PROGRAMME

Auditorium 1 'Per Kirkeby'	Auditorium 2 'Merete Barker'	Auditorium 3 'Eduard Biermann'	Auditorium 4 'Jeppe Vontillius'	Room 5 'William Scharff'
	Christian Damgaard: State-space modeling indicates rapid invasion of an alien shrub in coastal dunes 21C + P39-41, P61-62	Gert Tinggaard Svendsen: How to promote green industries? – Emission trading, subsidies and innovation 22 Jørgen Brandt: Assessment of Health-Cost Externalities of Air Pollution in Denmark and Europe using the EVA Model System 23 Elena Boriani: Evaluation of soil ecosystem health and services according to sustainability thresholds for industry impacts 24	Irene Bouwma: Management instruments for Natura 2000 areas: Use or modify the old or develop something new? 27 Thomas Thaler: Use of environmental benefits in policy decision process 28 Massimo Pizzol: The role of time scale in assessing external costs of metal emissions 29	
12:50 Lunch				
13:40 Workshop session	Workshop session	Workshop session	Workshop session	Workshop session
Data collection and data strategy 30A Workshop leader Lise Marie Frohn	Evidence based nature management. 30B Workshop leader: Peter Borgen Sørensen	Nature management in a climate perspective. 30C. Workshop leader: Flemming Skov	The battle for land. 30D. Workshop leader: Jim Smart	Management tools. 30E Workshop leader: Brian Kronvang
15:10 Coffee break				
	Special session	Special session	Contributed session	
	The economics of water quality Chair: Marianne Zandersen Marianne Zandersen: Bio-engineering in the Baltic Sea – value of water quality improvements & risk perceptions 31A Berit Hasler: Integrated modelling to support cost-effective management of nutrient reductions to the Baltic Sea 31B Jim Smart: A translog approach for estimating the costs of improving waste water treatment in catchments draining into the Baltic Sea 31C	Constructed wetlands Chair: Carl Christian Hoffmann Carl Christian Hoffmann: Comparing two surface flow wetlands for removal of nutrients in agricultural drainage water 32A Karin S. Tonderski: Nitrogen and phosphorus removal in Swedish agricultural wetlands 32B Børje Ekstam: Many plants are wanted, but are they colonizing constructed wetlands? 32C Charlotte Kjaergaard: Drainage filters and constructed wetlands to mitigate site-specific nutrient losses 32D	Topic 1: Directives II Chair: Nikolai Friberg Ellen M. Basse: A New Regulatory Design used by the EU – with the promotion of renewable energy as an example 33 Marlon Boeve: Sustainable urban development: the integrated approach 34 Mireille Bogaart: Flexibility in the European legal framework on air quality 35 Ursula S. McKnight: Integrated assessment of the impact of aqueous contaminant stressors on surface water ecosystems 36 Jonida Abazaj: Environmental Politics and the Need for Reconciliation: The case of the Water Framework Directive and the Renewable Energy Directive 37	
17:10-17:45 Concluding plenary session: Feedback from workshops				

MAIN TOPICS

Meeting European environmental legislation

– the Directives under scrutiny.

Abstracts: 1-8 + 33-37 + P38, P44, P45, P54, P55, P57, P65

2010 behind us – is biodiversity in free fall?

Abstracts: 12-15 + P43, P46, P53, P58

A low impact, low carbon economy

– socio-economic implications for ecosystems and human health.

Abstracts: 22-24 + P46, P47, P52, P56

Making decisions - management tools of the future.

Abstracts: 17-20 + 25-29 + P38, P42, P44, P45, P51, P52, P59, P60, P63, P64

SPECIAL SESSIONS

Links between biodiversity and soil ecosystem services

Abstracts: 9A-E

The impacts of green energy policies on transformational processes within the context of the contemporary rural landscape. A comparative analysis of three European national and regional scenarios (France, Italy and Spain)

Abstracts: 10A-D

Aquarius: Bridging the gaps between science, regulation and practice in water environment management

Abstract: 11

Climate models: uncertainties, effects and adaptation

Abstracts: 16A-D

Science-based nature management

Abstracts: 21A-C + P39-41, P61-62

The economics of water quality

Abstracts: 31A-C

Constructed wetlands

Abstracts: 32A-D

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P38	Maria Loinaz, Hasse Davidsen, Michael Butts and Peter Bauer-Gottwein	Assessing eco-hydrological impacts of temperature changes at the catchment scale
P39	Andrea Oddershede Christensen and Christian Damgaard	Responses in plant communities to extreme precipitation events
P40	Christian Damgaard, Bettina Nygaard, Rasmus Ejrnæs and Johannes Kollmann	State-space modeling indicates rapid invasion of an alien shrub in coastal dunes
P41	Christian Damgaard	Plant cover modelling
P42	Jelena Djokic	Impact analysis of magnesium slag deposit in changing climate conditions
P43	Ana Maria Dodocioiu, Iulia Anton and Susinski Mihai	Setting up nitrates vulnerable zones in Romania
P44	Pia Frederiksen	Indicators in the science-policy interface – are they influential?
P45	Jesper Fredshavn, Bjarne Søgaard, Bettina Nygaard, Knud Erik Nielsen, Rasmus Ejrnæs, Stefan Pihl, Jesper Bladt, Poul Nygaard Andersen, Christian Damgaard and Flemming Skov	A mapping and monitoring programme supporting the Natura-2000 management plans
P46	Masatoshi Funabashi	Foundation of Synecoculture: Toward an agriculture of synthetic and profitable ecosystems
P47	Anna Bodil Hald and Anne Lisbeth Nielsen	Land use on humic soils – different outcomes
P48	Birgitte Hansen, Lærke Thorling, Tommy Dalgaard and Mogens Erlandsen	General national downward trend in the nitrate concentrations of Danish groundwater since 1980
P49	Thomas Eske Holm, Bjarne Søgaard and Poul Nygaard Andersen	Can citizen science improve or substitute a national programme, monitoring species included in the EEC Habitats Directive?
P50	Vishal Chandr Jaunky	Is there a material Kuznets curve for aluminium? Evidence from rich countries
P51	Bjarke Stoltze Kaspersen, Torsten Vammen Jacobsen, Michael Brian Butts, Eva Boegh and Tyge Kjær	Linking WFD river basin management planning and climate change challenges
P52	Alexia Koletsou and Rebecca Mancy	Distinguishing between individual and collective forms of efficacy and outcome expectations for risk mitigation in large-scale collective problems
P53	R. Mocanu, Ana Maria Dodocioiu, M. Susinski and M. Dobre	The ecological recovery of coal gangue dumps in Romania
P54	Sbartai Amel, Namour Philippe and Jaffrezic Nicole	Micro-system for heavy metal measurement in water
P55	Anne Lisbeth Nielsen, Anna Bodil Hald and Rita Buttenschøn	Semi-natural grassland in Denmark – political instruments aiming for nature quality
P56	Lee Pei-Ling	The prospect of global climate regime: Effective enforcements and empowerment
P57	Massimo Pizzol and Marianne Thomsen	Danish WEEE management in the light of the WEEE and RoHS Directives: a quantitative analysis of critical issues
P58	Jes Rasmussen and Annette Baattrup-Pedersen	Microbial litter degradation across a land-use gradient of Danish streams
P59	Sandro Sacchelli, Isabella De Meo and Alessandro Paletto	Bioenergy production and forest multifunctionality: a trade-off analysis based on multiscale spatial tool
P60	Ajay Sehgal	Sustainable management of degraded ecosystem with engineering interventions-a success story
P61	Marie Paarup Thomsen	Can mowing and sheep grazing on wet heath reverse the decline in the density of <i>Erica tetralix</i> ?
P62	Allan Timmermann, Christian F. Damgaard, Morten T. Strandberg and Jens-Christian Svenning	Short-term trends in vegetation cover of Danish semi-natural eco-systems – a landscape-ecological assessment of main drivers indicated by traits of winner and loser species
P63	Wei Wei, Isabelle Alvarez and Sophie Martin	Sustainability and time horizon
P64	Jørgen Windolf, Gitte Blicher-Mathiesen, Jacob Carstensen and Brian Kronvang	Nitrogen loadings and concentrations to estuaries in Denmark during the period 1990-2009: Regional differences in sources, loadings, sinks and estuarine responses
P65	Andrew J. Wright, Sarah J. Dolman, Michael Jasny, E.C.M. Parsons, Doris Schiedek and Sharon B. Young	Myth and momentum: An assessment of environmental impact assessments



BRIDGING THE GAP BETWEEN SCIENTISTS AND PRACTITIONERS IN ENVIRONMENTAL SCIENCE

EXPERIENCE FROM IMPLEMENTING THE WATER FRAMEWORK DIRECTIVE

Roger Owen; Head of Ecology, Scottish Environment Protection Agency

Abstract

The Water Framework Directive is widely considered to be a progressive and innovative legislative driver for improving the quality of European surface waters. The Directive requires ecologically based assessments, indicators of a wide range of environmental pressures, and ecological status related to the degree of change from an agreed type-specific reference, or unmodified, condition. All surface waters are required to meet defined objectives which are ecologically close to reference. There has been a great deal of effort to intercalibrate national assessment systems across Europe. The Directive is grounded in economic reality and objectives for water bodies take account of those already heavily modified for specific human uses and for which restoration to near natural condition would be infeasible; even though this economic test is not easy or straightforward. A key underpinning element of the Directive is the delivery of objectives through statutory catchment plans inclusive of a range of stakeholders.

However, there are also some difficult issues still to be resolved. Although EU intercalibration of ecological status has been innovative and largely successful, compliance with agreed reference has been fairly poor so far. Alignment of methods for lakes and coastal waters has been problematic. The level of ambition and timescales for achieving ecological objectives varies widely across the

EU and countries differ in how to take account of invasive non-native species in ecological assessment. Experience in Scotland over the last 8 years has been reasonably good. River basin planning is well organised, stakeholder participation is good and there are advanced plans for meeting water body objectives within specific timescales. We now have a comprehensive view of where the pressures are and the measures required to meet objectives. But the availability of up to 3 river basin planning cycles has led to backloading of planned measures where these are more difficult, financial incentives for some non-regulatory measures are available but not always well targeted at the catchment scale, and designation of heavily modified rivers has proved a difficult concept in an agricultural setting.

It can be argued that achievement of consistent EU-wide ecological status objectives is a rather narrow focus and that a more flexible, and inclusive, approach to catchment management requires an ecosystem services approach to environmental risk management. It is also important to demonstrate good value for money for taxpayer funded measures by the achievement of multiple benefits for flood risk management, biodiversity, climate change mitigation and other potential environmental gains.

SCIENCE BASED NATURE CONSERVATION IN EUROPE; LESSONS FROM THE HABITATS DIRECTIVE

Doug Evans; European Topic Centre on Biological Diversity

Abstract

Modern day Nature Conservation has many and varied origins and in the second half of the 20th century the discipline of Conservation Science began to develop, bringing together ideas from ecology and nature conservation. Today this is a well recognised field with several dedicated journals. Conservation Science gives both a theoretical base to nature conservation and the practical techniques and methods required. It should also allow us to learn from past mistakes and successes.

The 1992 Habitats Directive is a typical example of the interaction between science & legislation, it addresses a clear problem (the loss of biodiversity) using protected areas & species protection, both well established as appropriate responses, and relies on reliable scientific information for its implementation. However, it is clear that in many instances the necessary science was lacking or the information available incomplete. The Directive also includes some definitions which are difficult to use or terms which are not defined at all.

The list of species & habitats to be protected was largely based on expert opinion using the knowledge available in the late 1980s for an EU of 12 countries. The 1992 list of habitat types was largely based on the CORINE biotopes project but little information was available on the distribution and extent of many habitats although some types were clearly threatened with widely reported losses of habitats such as peatbogs and haymeadows. Since 1992, Annex I has been extended due to successive EU enlargements and today includes 231 habitat types which differ widely in their inherent variability. Although an Interpretation Manual has been produced by the European Commission there are clearly differences in how the ha-

bitats are interpreted between countries, and sometimes between regions of the same country.

In most countries a lack of comprehensive inventories for some species groups or habitat types meant that site selection was also often based on expert opinion and existing protected areas. As a result of the Directive many countries have undertaken recent surveys and our knowledge of many groups has improved. With the obligation to report on the conservation status of each habitat type and species every 6 years under Article 17, our knowledge should improve. The 2007 assessments of Conservation Status also showed that better coordination between countries is required for future reports and the recently published guidelines for the next reports, due in 2013, have hopefully learnt from previous errors.

Recent publications such as regional Redlists show that many species which could qualify for listing on one or more annexes were omitted, in many cases due to poor information. It is also possible that some species and habitats currently listed to do not require such protection at a EU scale.

Although many of the problems in implementation are 'political' in nature these are often made more difficult to resolve by poor information which hinders communication.

As our knowledge of Europe's biodiversity improves there is an increasingly strong argument to revise the annexes of the Directive and the European Commission has acknowledged this although it is likely to be several years before any changes occur.

PHOSPHORUS MANAGEMENT IN AGRICULTURAL SYSTEMS

Andrew Sharpley; Department of Crop, Soil, and Environmental Sciences, Division of Agriculture, University of Arkansas, Fayetteville, Arkansas, U.S.A.

Abstract

The accelerated eutrophication of freshwaters and to a lesser extent some coastal waters is primarily driven by phosphorus (P) inputs, predicated its management in point and nonpoint sources. While efforts to identify and limit point source inputs of P to surface waters have seen some success, nonpoint sources have remained more elusive and more difficult to identify, target, and remediate. As further reduction in point sources of P discharge via innovative wastewater treatment technologies becomes increasingly costly, attention has focused more on nonpoint source reduction and particularly the role of agriculture. This attention was heightened over the last 10 to 20 years by a number of highly visible cases of nutrient-related water quality degradation; including the Baltic Sea, Chesapeake Bay, Florida Everglades, and Gulf of Mexico. Compounding the concerns derived from these cases is the more recent admission that impaired water quality has not seen as great an improvement as predicted by model predictions and expected from widespread adoption of conservation management strategies. Thus, there has recently been a strategic shift from treating water quality impairment through unilateral catchment conservation measures to targeting management to critical sources of P loss.

In the past, separate strategies for improving either nitrogen (N) or P management have been developed such that advice given to control P loss can conflict with advice given to control N loss. These conflicting recommendations must be brought into alignment.

Because of different critical sources, pathways, and sinks controlling N and P export from catchments, remedial strategies directed at either N or P control can negatively impact the other nutrient. For example, basing manure application on crop-N requirements to minimize nitrate leaching to ground water, has increased soil P and enhanced the potential P for loss. Whatever strategies are implemented, they should be done in an adaptive manner, as the complexities imparted by spatially variable landscapes, climate, and system response will require iterative, locally relevant solutions. For example, system response can vary from a year to several decades and this time generally increases as spatial scale increases. At a field and farm level, research has demonstrated edge-of-field reduction in nutrient and sediment loss can occur within months of changing P-management. However, the spatial complexity of catchment systems increases this response time for P as a function of slow release of legacy P stored in soils and fluvial sediments to surface flow pathways. Even so, it is difficult for the public to understand or accept this lack of response. When public funds are invested in remediation programs, rapid improvements in water quality are usually expected and often required. Thus, future programs must address this, as well as the involvement of farmers to demonstrate what conservation measures work, along with their socio-economic consequences. Finally, this paper will discuss the environmental sustainability of conservation measures in relation to what we have learnt from past implementation efforts and the realities of day-to-day farm management decisions.

MANAGEMENT **PLANNING** SYSTEM FOR NATURA 2000 SITES

Lars Rudolf; Head of Section, Danish Nature Agency, Denmark

Abstract

The EU Habitats and Birds Directives require the designation of a network of special sites for the protection and conservation of species and habitats of European importance, the so-called Natura 2000 network. The directives include provisions for EU Member States to establish conservation measures, to take appropriate steps to avoid deterioration of the sites and to maintain or to restore the conservation status of habitats and species.

Denmark has over the past 10 years developed a system for legally binding management plans for the Danish part of the network, inspired by the management plan system issued by the Water Framework Directive, combined with the development of scientifically based methods for assessing conservation status of habitats. The development of the conservation status assessment methods has been based on and supported by extensive mapping and sur-

veillance of the habitats and species for which the sites are designated. Furthermore, the establishment of conservation objectives and prioritisation of measures for the sites has taken into consideration the results of the surveillance of conservation status, which has been reported to the EU.

The presentation will make a brief introduction to the principles of the Danish Natura 2000 management planning system and describe the inter-action between the scientifically based development of operational method and practical management planning. Furthermore the presentation will discuss the perspectives and challenges in the follow up of the plans.

CHALLENGES IN DEVELOPING PESTICIDE INDICATORS AND SETTING TARGETS

Lise Samsøe-Petersen; biologist, Danish Nature Agency, Denmark

Abstract

The EU Framework directive on sustainable use of pesticides (2009/128/EC) requires member states to establish national pesticide action plans and requires that a number of items are included in those plans. It also requires a harmonised pesticide risk indicator to be developed. When developed member states shall calculate this harmonised risk indicator at member state level and report to the Commission after which the Commission shall calculate risk indicators at community level. This in order to estimate trends in risks caused by the use of pesticides in EU and to assess the progress in achieving the objectives of the community policies aimed at reducing the impact of pesticides on human health and the environment.

However, developing pesticide risk indicators that can be applied throughout Europe and which will actually indicate and describe the progress achieved regarding reducing pesticide risks is quite a challenge. The EU Commission has developed an indicator (HAIR) that is now being further assessed. The Danish EPA has also developed an indicator, just as a number of other countries within Europe as well as in other parts of the world have developed their own indicators.

The challenge in developing a pesticide risk indicator that will actually show the development in the risk and effect on human health and the environment caused by the use of pesticides will be discussed.

THE **WATER FRAMEWORK DIRECTIVE** – A DIRECTIVE FOR THE TWENTY-FIRST CENTURY?

Henrik Josefsson¹ & Lasse Baaner²

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² University of Uppsala, Faculty of Law University of Uppsala, Faculty of Law, Sweden; University of Copenhagen, Faculty of Life Sciences, Denmark

Abstract

This article addresses the Water Framework Directive and the legal norm of 'good ecological status', which refers to the structure and function of ecosystems. In terms of ecology, the concepts of good structure and function reflect a resilient ecosystem with a high level of adaptive capacity. However, the legal provisions of the Directive compromise this concept. The Directive's approach assumes that quantifying certain fixed biological elements it is possible to accurately assess the structure and function. This approach is highly contestable, and undermines the possibility of attaining the objective of 'good ecological status'.

To improve the possibility of achieving 'good ecological status', we emphasize the need to first redefine 'high ecological status' as a state wherein the ecosystems maintain themselves independently of management, secondly, that the hydrological regime be addressed when assessing the bodies of water, and, thirdly, that traits, rather than the current 'quality elements' be used as variables.

Keywords: Water Framework Directive, biological classification systems, biological quality elements, ecosystem services, traits, ecosystem management.

ARE WE MEASURING WHAT WE NEED TO MEASURE?

THE **ECOLOGICAL ASSESSMENT** FOR MANAGEMENT OF EUROPEAN **MARINE** AND **FRESH WATERS**

Wouter van de Bund¹, Sandra Poikane¹, Wendy Bonne¹, Nikolaos Zampoukas¹, Sandra Brucet-Balmanas¹, Sebastian Birk²
& Ana Cristina Cardoso¹

¹ European Commission Joint Research centre, Institute for Environment and Sustainability, Ispra, Italy

² University Duisburg-Essen, Germany

Abstract

The aim of the European Union's ambitious Marine Strategy Framework Directive (adopted in June 2008) is to protect more effectively the marine environment across Europe. It aims to achieve good environmental status of the EU's marine waters by 2020 and to protect the resource base upon which marine-related economic and social activities depend. This goal is in line with the objectives of the Water Framework Directive (2000) which requires surface water bodies - such as lakes, streams, rivers, estuaries, and coastal waters - to reach "good ecological status" by 2015. Therefore effective protection of the aquatic environment ultimately depends on defining scientifically defensible ecological target values and developing management plans to reach these goals.

In this paper we review the current state-of-the-art of the ecological assessment under both Directives across Europe.

We discuss the theoretical principles and practical applications in the following key areas: development of criteria and associated indicators, the definition of environmental targets, current status of the Water Framework Directive and Marine Strategy Framework Directive implementation process and defining future research directions.

Finally, we consider synergies between Water Framework Directive and Marine Strategy Framework Directive related to environmental quality standards and give recommendations to incorporate the assessment of ecological/environmental status into a more integrated framework also taking into account the services provided by freshwater and marine ecosystems.

TEN YEARS OF WFD IMPLEMENTATION IN EUROPE: A **CRITICAL REVIEW** BASED ON THE EXPERIENCE MADE IN GERMANY.

Dietrich Borchardt, Sandra Richter & Ilona Bärlund; Helmholtz Centre for Environmental Research-UFZ, Magdeburg, Germany, dietrich.borchardt@ufz.de

Abstract

Where do we stand on water protection in Germany ten years after the introduction of the European Water Framework Directive (WFD)? – a European environmental directive, which for many stakeholders was not just another bureaucratic monster from Brussels, but an innovative instrument and a bearer of hope for better water protection. The formal conversion to national law and the implementation of the planning processes in Germany have essentially been met but one conclusion of the implementation process is that certain key issues of river basin management have been accomplished by state-specific regulations rather than by nationwide accord. The figures on the status of water bodies are however disillusioning: we are still a long way off the main target of achieving a “good” status of surface and groundwaters by 2015. In fact, “exemptions for achieving objectives” have been applied to 82% of all surface water bodies. The good news is that a “good chemical status” particularly in the reduction of wastewater loads from industry and settlements, which is not owing to the implementation of the WFD but to the consistent application of the “polluter pays principle” (PPP) in the wastewater sector over recent decades. However, it must be noted that only some of the German states have applied the modified requirements by the Environmental Quality Standards Directive (2008/105/EC) at the time of the status assessment. This will reduce the water bodies with a “good chemical status”.

Granting extensions for the achievement of objectives is both inevitable and correct, but does this not ultimately lead to “minor environmental objectives”? And would this not do disservice to water protection with its exhaustive reporting and evaluation procedures? Our concern is: “yes” if we do not simultaneously make substantial progress on the following points:

1. PPP should also be applied to those users who share major responsibility for the ecological deficits and the loss of ecological functions today.
2. Solve the lack of available land for nature and water protection. River corridors that are sufficiently wide would create more habitats and at the same time reduce agro-chemical loads but due to bioenergy demands land use pressure is set to even increase in the near future.
3. A more effective water protection must be embodied consistently in agro-environmental measures. It must be decided where non-binding measures are insufficient and therefore where restrictions of use should apply – with or without compensation.
4. At present climate change impacts and accompanying adaptation strategies are still given little consideration in management plans. However, actual or anticipated influence of climate change should not be used as a reason for not having implemented necessary water protection strategies in the future

The focus for future water protection strategies should actually be outside of the field of water management itself, i.e. in agriculture, energy production and transport. The WFD thereby still provides an opportunity but no guarantee for achieving the required amount of water protection through an ecologically feasible design. The reconciliation of different users' interests from completely different fields of policy will play a major role in achieving ecological objectives and this calls for unconventional instruments.

ECOLOGICAL FUNCTION AND **BIODIVERSITY INDICATORS** IN EUROPEAN SOILS

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Abstract

Soils provide numerous essential ecosystem services such as: primary production (including agricultural and forestry products); regulation of biogeochemical cycles (with consequences for the climate); water filtration; resistance to diseases and pests; and regulation of above-ground biodiversity.

The European Commission aims to define a policy for the sustainable management of soils with a view to adopting a legally binding Soil Framework Directive. Scientific and technological knowledge on soil biodiversity and functioning is required to reach this goal.

Soils host a huge biodiversity (microbes and fauna) of which our understanding remains very limited due to the small size of the soilborne organisms; their immense diversity; the difficulty in isolating them; and the great heterogeneity of their habitats.

The EU FP7 project EcoFINDERS (**E**cological **F**unction and **B**iodiversity **I**ndicators in **E**uropean **S**oils) (project period 2011-2014) will result in:

- increased knowledge of soil biodiversity and its role in ecosystem services
- standardization of methods and operating procedures for characterizing soil biodiversity and functioning, and the development of bioindicators

- assessment of the added value brought by cost-effective bioindicators, and of cost effectiveness of alternative ecosystem service maintenance policies.

The soil biodiversity studied includes microbes (archaea, bacteria, fungi) and fauna (protozoa, microarthropods, nematodes, oligochaeta), and their relation with above-ground biodiversity.

The corresponding research combines three approaches:

- description of soil biodiversity and of the relations between soil biodiversity, soil functions and ecosystem services, in long term observatories representative of soil types, climates and land uses across Europe,
- experiments to test the biodiversity patterns and bioindicators identified, and hypotheses related to connections between soil biodiversity and functions,
- metadata analyses to raise a biodiversity database at the European level,
- modeling to decipher relations between soil biodiversity and functions,
- putting a value on ecosystem services.

ECOLOGICAL PROPERTIES OF EARTHWORM BURROWS IN AN ORGANICALLY MANAGED GRASS-CLOVER SYSTEM

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Abstract

Earthworms have long been recognized for their soil engineering capacities. Since the creation of the ecosystem service concept the utilitarian perception of nature has gained a lot of attention and funding for research. Hence, we selected earthworms and their burrowing activities to enable an assessment of their influence on water movement and nutrient release. The study went on in autumn where earthworm population densities and their burrowing activities were quantified in plots of third year clover-grass crops differing in fertilisation and the manner of removing the biomass either by grazing or cutting. We

found very high biomasses as expected for clover-grass about 200 g wet earthworm weight m⁻². The common earthworm association typical to our region was: *Aporrectodea tuberculata*, *Aporrectodea rosea*, *Aporrectodea longa* and *Lumbricus terrestris*, i.e. two endogeic and two anecic species. We present our results on the burrow size distribution down the soil profile and link it to the species and species traits. The results are further put into perspective in our present research on macropores related to soil ecosystem services and pesticide leaching.

IDENTIFICATION, FUNCTIONAL ROLES AND ECOSYSTEM SERVICES OF PROTOZOA IN SOIL

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Abstract

Protozoa are the major consumers of bacterial production in soil, forming the base of the heterotrophic eukaryotic food web that channels the energy flow via bacteria to higher trophic levels in soil (i.e. the bacterial energy channel). Despite small sizes of protozoa in soil (5-200 µm), their high abundance and fast turnover make them one of the key regulators of bacterial biomass and nutrient cycling.

Even though they occupy important functional roles, we still have only a vague idea on the identity of the dominant protist taxa in soil. One major reason for the general ignorance of protists in environmental studies is methodological difficulties in quantifying small protists in the opaque soil environment, their uneven distribution and the lack of taxonomic expertise. However, recent developments in high-throughput sequencing and in the cultivation of so-called uncultivable protists now allow closing the methodological gap on this functionally important trophic link in the soil food web.

Within the EU-project EcoFINDERS we aim at designing

DNA-based barcodes for dominant protozoan taxa in soil. Protozoan diversity will be compared between five long-term observatories across Europe using high-throughput sequencing.

Protozoan grazing of bacteria has been shown to be a major structuring force for bacterial diversity in the plant rhizosphere. Therefore we suggest that protozoa may provide an important ecosystem service by removing pathogenic microorganisms from soils. Laboratory experiments with selected dominant protozoan taxa will be performed to investigate the effects of protozoan predation on different pathogenic and beneficial soil microorganisms.

Preliminary results indicate that bacterial spores are resistant to predation i.e. germinate and grow inside food vacuoles, while vegetative bacteria are killed by protozoan predation. This will be tested along with the dependency of morphology and feeding behaviour of protozoa on bacterial predation and related to soil ecosystem services.

IMPACT OF FUNCTIONAL MICROBIAL DIVERSITY ON SOIL ECOSYSTEM SERVICES AND ASSESSMENT THEREOF

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Abstract

Microorganisms are key players in many soil ecosystem services: turnover of organic matter, including anthropogenic organic compounds, remineralisation of essential nutrients for plant growth, plant beneficial microorganisms, plant, animal and human pathogens, and competition and dilution of pathogens. Microbial diversity is responsible for these services but knowledge of the exact functions of the microbial diversity are scattered. In the EU FP7 EcoFIN-DERS project techniques of measuring microbial functional diversity such as MicroResp (Campbell et al 2003) and Enzyme Activity Assay (EAA) (Winding and Hendriksen 2007) are being optimized, standardised and compared across soils with different land-uses from European long-term observatories.

The MicroResp technique is partly growth dependent and measures the microbial respiration of a selected range of carbon substrates while the EEA is a growth independent assay of enzymatic activity. These techniques are chosen as they are mimicking vital functions of the microbial communities in carbon and nutrient turnover and hence are possible candidates as indicators of microbial biodi-

versity and soil ecosystem services. In addition, they are among the top prioritized potential biological indicators of soil monitoring (Ritz et al. 2009). They and other microbial diversity techniques will be evaluated for use as indicators of biodiversity and soil ecosystem services.

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ECONOMIC ANALYSIS OF CONSERVATION IN SOIL BIODIVERSITY AND ECOSYSTEM SERVICES

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Abstract

A premise for economic valuation of soil ecosystem services; and through this soil biodiversity, is that society values soil ecosystem services to the extent that they fulfil needs or confer satisfaction to humans either directly or indirectly (de Groot et al., 2002; Fisher and Turner, 2009). This is based on the notion that soil biodiversity can be seen as natural capital, and the flow of soil ecosystem services is the "interest" on that capital (Perrings et al., 2006). Just as private investors choose a portfolio of capital to manage risky returns, society needs to choose the level of soil biodiversity to maintain the flow of soil ecosystem services for human well-being. It follows that when the value of soil ecosystem services is unknown, policy could be misguided and society would be worse off due to insufficient investment in soil conservation.

The research is developed as part of the ECOFINDERS project that attempts to link soil biodiversity to ecosystem

services and their economic valuation. The paper presents an economic analysis framework for soil ecosystem service valuation, gives an overview of the current literature and discusses the main challenges for development of policy relevant economic analyses to guide soil conservation.

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A COMPARATIVE ANALYSIS OF THREE EUROPEAN NATIONAL AND REGIONAL SCENARIOS (FRANCE, ITALY AND SPAIN)

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Abstract

In several European countries, the coming into force of the EU policy concerning renewable energy regulation (Livre vert de l'Union Européenne « Vers une stratégie européenne de sécurité d'approvisionnement énergétique », COM (2000) 769 and European Community Directive 2001/77) has often led to excessive preoccupation with the achievement of the quantitative production objectives established in the European Burden-Sharing Agreement (June 1998 EU Environment Council).

Given that large-scale green energy power plants are often located in agricultural areas, the purpose of the proposed special session is to discuss the interactions between agriculture and green energy, as well as the reasons for their juxtaposition.

Ecological damage, as well as various emerging problems related to land use conflicts in agricultural contexts affected by this large-scale transformation process, have emerged in the last few years as a major topic of national and local public debate.

Moreover, the recent coming into force within most European countries of an important outline document and of the European Landscape Convention has led to the introduction of a new point of view on aesthetic and perception quality into the local, national and supranational collective debate about the material and non-material impacts of energy policy on the transformational processes of the rural landscape (cf. ELC, Article 6 – Specific measures, D. Landscape quality objectives).

Focusing on the relationships between the current energy policies (solar and wind power plants) in three major European countries and the transformational processes within the evolving context of contemporary rural landscapes, the following questions will be explored by the international scientists attending the four scheduled presentations:

- Is it possible to ascribe the reasons for the close relationship between green energy and agricultural production to the current crises affecting the agricultural economic cycle?

- In the light of the recent political changes in green energy strategic orientation, may we consider the fulfilment phase of the European renewable energy burden-sharing standards agreement to be almost totally complete?
- Can we identify the emergence of new multi-scale political interest (European, national, regional, local) in landscape quality and not merely in simple quantitative management?

To provide an answer to these main questions, the special session will methodologically examine and compare three European examples in France, Italy and Spain. The proposed comparative analysis will particularly focus on the interdependencies between different supranational, national and local decisional levels in the field of green energy policy, and their relevant implications on current environment change within the three European countries. We intend to stress particularly the socio-economic, ecological and aesthetic points of view involved in the evaluation of the material and non-material impacts of green energy directives on the contemporary rural landscape. The analysis of each national case study will involve an examination of a particular regional scenario (Région Centre in France, Regione Puglia and Regione Lombardia in Italy, Comunidad Autónoma de Andalucía in Spain), as well as a site-specific solar or wind energy plant installation.

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THE FRENCH NATIONAL AND REGIONAL CONTEXT: REGION CENTRE – VALLÉE DE LA BEAUCE

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National and regional legislation

The French regulations concerning national renewable energies policies have been strongly influenced by the national conciliation process, known as Grenelle de l'environnement, conducted from July 2007 by the French Ministry for Ecology and Sustainable Development. The working groups dealing with this conciliation process were formed of public and private national stakeholders, from the level of central government to that of local collectivities, and extended the major Sustainable Development principles to the various local levels of application (regional, municipal, etc.).

The target of reducing national fossil energy consumption by 38% and of obtaining 23% of total national energy production from renewable resources before 2020, has been the major challenge for the Grenelle de l'environnement Working Committees.

The national Plan for the development of renewable energies with high level environmental quality, which came into force in September 2008, provides a set of regulations specifically aimed at promoting the development of green energy production, and outlines the central and local administrations' strategies for achieving the scheduled objectives. The policy adopted by France's central Government of not excluding any type of green energy installation plant has nevertheless had an extremely large ecological and socio-economic impact.

Geographic and socio-economic data

The territory of the Beauce Plateau in the French Région Centre is characterised by intensive cereal production, which in the last thirty years has been combined with a bio-energetic exploitation system (Colza and Miscanthus). Since 2005 the local administrations have decided to shift towards a more specific wind power scheme, with the result that the plateau has become the leading national wind energy producer (471 MW of total production). After considering the possibility of converting two former military bases in Beauce Plateau agricultural areas, the regional administrations have adopted a new manage-

ment strategy focusing on the construction of several large-scale photovoltaic plants. These new regional regulations have led to an increase in local public debate about the evaluation of the positive and negative effects of this new Directive-driven legislation, especially concerning the possible synergistic implementation of energy and agricultural policies.

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THE **ITALIAN** NATIONAL AND REGIONAL **CONTEXT**: REGIONE PUGLIA – PARCO NAZIONALE DELL'ALTA MURGIA; REGIONE LOMBARDIA – REGIONE RURALE PADANA

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National and regional legislation

With a target of 3000 MW of Nominal Power to be provided by photovoltaic installations by 2020, the first Italian national regulation code on renewable energies, Conto Energia 2005, has led to considerable speculation related to the massive increase in the number of large-scale power plants. In September 2010, this legislation code was supplemented by the National Guidelines for the authorisation of renewable energy installations, drafted by the Italian Ministry for Economic Development. With an explicit reference to the European Community Directive 2001/77, which relates to the promotion of renewable energy production, to the European Landscape Convention and to the Italian Code of Cultural and Landscape Heritage (Codice Urbani, 2004), these Guidelines seek "to regulate the authorisation process for the installation of renewable energy power plants and to ensure an appropriate integration of these installations into the landscape".

Between December 2010 and January 2011, the implementation of the National Guidelines led to the establishment by each Italian Regional Government of a range of site-specific regulations and of a management strategy and a local criteria classification to identify the suitable and unsuitable areas for renewable energy plant installations (Regional Guidelines).

The Apulia Region and the Lombardy Region Administrations have, in fact, promptly responded to this recent national regulation by listing areas unsuitable for the installation of green energy plants and formalising the Regional Land Inventory of Renewable Energy Sources. These actions provide a basis for working out site-specific policies for territory management and land use, with specific reference to the development of the rural areas.

Geographic and socio-economic data

Within the Apulia regional context, this new regulation frame has produced important consequences on the productive cycle of the agricultural and zootechnical enterprises located in the area of the Alta Murgia National Park, the first Italian Rural Park established in 2005 in the hinterland of the Mediterranean town of Bari. The partial conversion of agricultural production into agro-energetic crops, as well as the increasing production of biomass and biogas for green energy production by the zootechnical industry, have emerged in the last few years as two major activities spurred by the local Apulia institutions. They both represent a successful model of economic development for the agriculture and livestock farm enterprises in the Alta Murgia rural region, which has been traditionally marked by an intensive cereal production and livestock farming and which is now becoming an increasingly prominent player on the national green energy scene.

The organisation of a local district for agroenergetic production and of a regional cluster for renewable energies and energetic efficiency (La Nuova Energia. Distretto Produttivo delle Energie Rinnovabili e dell'Efficienza Energetica della Regione Puglia) is, for example, a major factor to thwart the economic crisis and the social isolation of the rural activities in the Alta Murgia area, as well as a solid platform to construct a new model of direct interaction and participation between public and private local players.

In the case of the Lombardy Region, the principal regional resource is currently hydroelectricity, the traditional "leader" in local energy production, but, as the morphology of the whole area is complex and heterogeneous, there are a variety of renewable energy scenarios. In the last few years, as part of the new regional energy policy, a number of new production targets have been established; the focus is on the implementation of photovoltaic power and biomass production.

One of the more important strategic challenges here is that facing the Padanian Rural Region, an extended territory lying between the provinces of Bergamo and Brescia, on the northwest border of the Lombardy Region, and those of Lodi, Cremona and Mantua, on the south-eastern regional border. The traditional agrarian character of this geographic area is still evident in the economic and symbolic values of the local people and leaders, values which partly derive from its historically rich natural and cultural resources.

The area's flat morphology and strong rural nature were crucial factors in the recent construction here of large-scale photovoltaic plants and in the conversion of agricultural land into large biomass production operations; it is an increasingly prominent player on the national green energy scene.

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THE **SPANISH EXAMPLE**: COMUNIDAD AUTÓNOMA DE ANDALUCÍA – ALPUJARRA ET VALLE DE LECRÍN; COMUNIDAD AUTÓNOMA DE CASTILLA Y LEÓN – COMARCA DE "LA MUDARRA"

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National and regional legislation

Due to its ambitious policies Spain has achieved a very successful implementation of renewable power. Installed capacity of wind power in reached 19.959 MW in 2010 and that one of solar PV power augmented up to 4188 MW. The Spanish National Renewable Energies Plan 2011-2020 (PANER, 2010) seeks to keep increasing installed capacity of renewables up to 69844 MW by 2020: the target for wind power installed capacity is 38000 MW and for solar PV power is 13445 MW.

As wind mills and solar PV power plants are spreading in Spain, cultural preferences for country landscape have become an increasingly important factor in their perception, especially the first one, which is described by some opponents as "wind-farm monoculture". Wind and solar powers have become an essential factor shaping the present-day Spanish landscape. In this context, more democratic forms of land-use policies emerged during recent decades clashed with hierarchical energy planning policy in Spain.

The renewables planning regime is related with energy, land use and landscape policies. The application of wind energy in Spain is a central government policy, but changing a zoning scheme is a regional political decision. Up until quite recently the prevailing model of spatial planning in relation to renewables development was hierarchical, authoritarian and functional. Land use is an autonomous regions policy, but at local level wind power promoters should respect local land-use plans. As

far as Spain's landscape policies is concerned, in spite of essential changes due to application of the European Landscape Convention, which encouraged several autonomous regions to incorporate landscape as an important issue in land use regulation, they are still out of step with the development of renewable energy policies.

Like many other Spain's autonomous regions Andalusia has not introduced landscape as a transversal element in its energy planning zoning scheme, though the Territorial Plan for Andalusia (2006) devotes special attention to landscape in regional planning as a valuable resource for development of this region. The regional Energy Law 2/2007 governs the promotion of electricity produced from renewable energies as well as energy-saving and efficiency in Andalusia, although there are no local examples of the landscape factor integration into wind or solar PV power planning in the Granada province.

Geographic and socio-economic data

The Comarca of Alpujarra and Valle de Lecrín (Andalusia, Spain) consists of 38 municipalities (municipios) with a population of 52 thousand inhabitants. It is situated in the south of the Granada province, in the South-East of Spain. This comarca has a traditional agrarian character (agriculture based mostly on olive and orange production in the lower parts and on vine, olive and almond production in the upper parts), although the farming sector is currently in deep crisis. This area has recently been developed for tourism owing to its exceptional landscapes and natural, ethnological and cultural resources. Moreover, La Alpujarra forms part of the Natural and National Parks of Sierra Nevada.

The Comarca is well suited to wind and solar photovoltaic power development (in Andalusia average annual wind speed at 80 m o.s.l. is about 5.5-6.5 and average daily solar radiation is about 4.75 kWh/m²). There are a dozen wind power farms, with 309.3 MW installed in Granada, seven of them in the area, and a few other projects under development. As in many other Spanish rural areas characterised by depopulation and socio-economic problems, wind and solar power are seen as a way to increase income and to raise its economic activity, although a problem of a lack of coherent planning is raising conflicts with regard to land use and to natural and cultural resources management.

Conclusions: New problems and opportunities in Spain's rural environment

In Spain, the social conflicts are not distributed equally in the territory because the planning process in each region it's different. Some tensions and conflicts are the consequence of the establishment of very broad objectives (as for example the straggle against the climate change), which are not accompanied by a realistic assessment of territorial and landscape potentials of specific areas where this infrastructures are placed, as in Andalusia. In others regions like Castilla y León local populations don't replay to this projects because they have not a territory and landscape concept about what is around them. Anyway wind and solar farms have been developed especially rapidly in rural areas characterized by the presence of this resource and grid connections.

The quick and disorganized siting process results in an intense transformation of rural landscapes. It generates tensions with local population in some cases (Andalusia) and indifference in others (Castilla y León). Proper land use and landscape planning and the improvement of the process of social participation could help to avoid many of these negative consequences of renewables development.

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BRIDGING THE GAPS BETWEEN SCIENCE, REGULATION AND PRACTICE IN WATER ENVIRONMENT MANAGEMENT

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Abstract

AQUARIUS is an Interreg North Sea Programme project carried out by 15 partners from 6 countries (Norway, Sweden, Germany, Holland, Scotland, and Denmark) all dealing with the implementation of the Water Frame Directive.

A primary objective of the project is to find ways for sustainable water environment management which by AQUARIUS is defined as management that in respect of the rules both leads to "good water environment", enables continued viable agricultural production, and is cost efficient in the interest of society.

AQUARIUS works from Social-Ecological management perspective emphasizing the intricate linkages between ecological and social systems and the interdependent relationships among humans, that are mediated through interactions with biophysical and non-human biological units.

As a project AQUARIUS copies the presently ongoing struggle by all EU member countries to create a public participatory approach to water management planning and implementation such as is launched by the EU Water Frame Directive. It does so by engaging central water authorities, representatives from agriculture including agricultural advisors as well as research institutions in carrying out localized pilot studies in 7 pilot areas. Drawing on localized experiments with and locally founded experiences with different measures the project derives

recommendations that may contribute to an EU policy approach.

The special session aims at discussing the preliminary findings of the ongoing project. It includes the presentation of a heuristic tool consisting of relevant considerations to beware of when engaging in stakeholder collaboration on specific measurements whilst acknowledging the farmer as the central water management practitioner.

The session also discusses some of the different pilot approaches to bridging the gaps between science, regulation and practice i.e. the concrete challenges faced by the approaches in trying to create outcomes that are mutually beneficial to various stakeholder interests. How can different stakeholders challenges be solved in cooperation creating a win-win situation for all? How can stakeholders (landowners) willingness to participate increase by seeing them as professional providers of eco-system services? When do stakeholders' overlapping interests allow for collaborative action and when do they hinder it? These questions are among the issues to be addressed.

One legal recommendation that may be derived from project experiences is a need to further to take the precautionary principle in public administration into account. In order to make sustainable solutions in an ever changing complexity, authorities need to make room for dynamic collaboration between science and practice.

IMPROVING THE SCIENCE-POLICY ON **BIODIVERSITY AND ECOSYSTEM SERVICES:** A MAJOR CHALLENGE FOR ENVIRONMENTAL **SCIENCE AND POLICY**

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Abstract

With the first plenary meeting of the new Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) taking place in Nairobi in parallel to the Science for the Environment Conference, we may step into a new era of the science-policy dialogue on pressing societal challenges like safeguarding biodiversity worldwide or ensuring long-term availability of ecosystem services. The long-lasting discussions about IPBES have shown that there is no easy solution to properly address the topic of biodiversity and ecosystem services in a science-policy platform for several reasons:

- the knowledge available is still scattered across many organisations, institutions and individual experts and a broad integration of knowledge across different disciplines is needed
- nevertheless, the baseline knowledge about the reasons for biodiversity loss and diminishing ecosystem services is well known, thus one focus must be on identifying options to tackle these reasons, not just on assessing status and trends
- loss of biodiversity and ecosystem services is a global challenge, but problems and their solutions will often need a focus on the local or the regional level, thus integration of knowledge from these levels is needed as well
- based on the recent experiences from the climate change debate and the IPCC, communication of results, uncertainties and the processes leading to these results will be of major importance

So, when designing the operational mode of IPBES and its work programme, these issues would need to be addressed. In addition, these challenges call for complementing a global body by further efforts to design similar interfaces on the regional and national level, to act together with IPBES as a “network of networks”, a concept recently developed by, inter alia, the European Platform for Biodiversity Research Strategy (EPBRS), to tackle some of these challenges.

The talk will discuss these challenges and present an initial prototype for such an approach, developed within the European project KNEU to develop a network of knowledge on biodiversity and ecosystem services – BiodiversityKnowledge, in Europe (www.biodiversityknowledge.eu). In order to properly tackle the goals and actions identified in the new EU Biodiversity Strategy for 2020, such approaches need rapid development to improve significantly the environmental decision making based on the best available knowledge.

THE BLURRED BASELINE: DENMARK'S UNKNOWN BIODIVERSITY

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Abstract

Estimating extinction rates is hampered by insufficient knowledge about which species actually exist. The project "allearter.dk", a project under the Danish Biodiversity Information Facility, DanBIF (Skipper 2011, Borchsenius et al. 2011, <http://www.danbif.dk>) enumerates all species known from Denmark, but during preparation of the species lists, it has become clear that even in a very thoroughly studied area like Denmark, where there has been a tradition for floristic and faunistic studies for centuries, the actual species pool remains insufficiently to extremely poorly known for many groups of non-charismatic groups of organisms, e.g., microarthropods, nematodes, microalgae, and several groups of fungi, let alone proper microorganisms. Every year, species new to science are discovered in Denmark (e.g., Buhl 2006, Grilli et al. 2009), and numerous previously described species are recorded as new to the country (e.g. Calabuig & Madsen 2009, Enghoff et al. 2011). Some of these are newcomers, or even invasive, but without doubt very many have simply gone unnoticed. Add problems of changing species concepts, changing names, and misidentifications, and the notion of a complete, stable census of Danish biodiversity at the species level seems to disappear beyond the horizon. Basic research on non-charismatic groups (which may be ecologically and eco-

nomically important) and increased involvement of non-professional naturalists will ameliorate the situation.

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LAND USE MANAGEMENT, ECOSYSTEM SERVICES AND BIODIVERSITY DEVELOPING REGULATORY MEASURES FOR SUSTAINABLE ENERGY CROP PRODUCTION (LÖBESTEIN)

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Abstract

Funded by the German Federal Ministry of Education and Research (FKZ 033L028A-E)

In the context of European and national biomass targets and action plans, an increasing share of energy crops in agricultural production can be expected in the coming years. To identify appropriate steering instruments and management systems for sustainable biomass cultivation, ecosystem services are analyzed and evaluated in the study region Görlitz district (Germany). As it includes economic, ecological and social aspects, ecosystem services can be a stimulus and a suitable tool to find appropriate solutions to identify or to improve legislative regulations or economic instruments (incentives) to channel energy crop production. Relevant core ecosystem services for local stakeholders in the Görlitz district are: food and feed production, soil fertility and ecology, protection of biodiversity and ethical values. Existing regulatory measures control the cultivation of energy crops only to a limited extent (Matzdorf et al. 2008). Examining regulatory measures like laws, subsidies, planning guidelines and regulation, it can be shown that these guidelines are not sufficient and unregulated cultivation of energy crops might have negative impacts on soil erosion, nutrient eluviations, biodiversity, landscape aesthetics and many other ecosystem services (Bastian et al. 2006, Hermann & Uckert 2009). In a next

step, there will be a search for improved or modified regulation mechanisms that are widely acceptable together with stakeholders. Results from this participatory approach will be converted into recommendations for both practice and decision makers. Also alternatives for existing and commonly used energy crops like maize and rape will be discussed and evaluated with biomass producers, e.g. short rotation coppice.

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EVALUATING AND COMMUNICATING SIMULATED WILDLIFE RESPONSES TO LAND-USE SCENARIOS

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Abstract

Reliable assessments of how human activities affect wildlife populations are essential for effective natural resource management. Agent-based models provide a powerful tool for integration of multiple drivers of ecological systems, but communication of model results is at the same time constrained by the complexity of the model responses. Here, we systematically modify a digital version of a real landscape to produce a set of model landscapes differing in the degree of heterogeneity and test how different landscapes affect abundance and occupancy of six model animal species in four different management scenarios using an agent-based model framework (ALMaSS). ALMaSS is capable of highly detailed modelling of individuals but the outputs can be complex and voluminous. We develop a statistic (the AOR-index) based on the abundance occupancy relationship to simplify presentation of model simulations and facilitate scenario comparisons. Scenario results demonstrate that species

respond very differently to a particular land-use scenario and in some cases in opposite directions. The bird and mammal species generally showed larger responses than the invertebrates and changes in occupancy were often smaller than changes in abundance. The species-specific responses are caused by differences in habitat requirements and dispersal abilities, but the importance of such life history traits are affected by landscape dynamics and structure. Hence predictions of species-specific responses to land-use changes in terms of abundance and occupancy are greatly improved by incorporation in a model framework taking spatial and temporal dynamics into account. The use of the AOR-index simplifies the presentation of scenario comparison and provides an objective way to combine impacts across species. Its use, however, still requires management goals in order to evaluate scenario responses.

CLIMATE CHANGE ADAPTATION STRATEGIES: WATER MANAGEMENT OPTIONS UNDER HIGH UNCERTAINTY – A DANISH EXAMPLE

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Abstract

This study takes a multidisciplinary approach for assessing the role of uncertainty in climate change impact assessment and adaptation analysis, applying generic frameworks for characterising uncertainty and adaptation options and using Danish adaptation measures as examples. Uncertainty is characterised according to three dimensions: level, source and nature, while adaptation options are characterised with respect to five dimensions: intent, action, temporal scope, spatial scope and structural/non-structural measures. With respect to uncertainty we observe that the dominating sources of uncertainty differ greatly among the various problems, that most uncertainties on impacts are epistemic (reducible) by nature, and that the uncertainties on adaptation measures are complex, with ambiguity often being added on top of the impact uncertainties. For adaptation characteristics we find great differences between types of adaptation measures in sectors dealing with urban and rural infra-

structures and sectors dealing with agriculture and freshwater ecology. The strategies to deal with uncertainty in climate change adaptation should reflect the nature of the uncertainty sources and how they impact the risk assessment and decision making: (i) epistemic uncertainties can be reduced by gaining more knowledge; (ii) uncertainties related to ambiguity can be reduced by dialogue and knowledge sharing between the different stakeholders to obtain a common perception of the problem at hand; and (iii) ontological uncertainty is by nature non-reducible, and we have to live with it. The uncertainty cascade includes many sources of uncertainty and their propagation through technical and socio-economic models may add to substantial prediction uncertainties. Nevertheless, even large uncertainties may in some contexts imply small consequences for decision making, because there is often sufficient knowledge to justify action in climate change adaptation.

DEVELOPMENT OF **DECISION SUPPORT MATRICES** FOR CLIMATE CHANGE ADAPTATION PLANNING

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Abstract

When deciding amongst a suite of various climate change adaptation options, decision makers have to balance uncertainties in potential physical impacts, economic judgements, and political priorities. A decision support matrix is a tool to aid in decision making, by clarifying the decision making process, highlighting key uncertainties, and identifying critical assumptions. Using a decision matrix allows decision makers to examine how different a

priori stakeholder values can impact the adaptation decision. We begin with a simple hypothetical decision matrix and build more complexity by adding multiple adaptation options, multiple risks, and multiple impact variables. The goal is to show where complexities enter into the decision tool, and then present ideas on how best to address these complexities under the context of adaptation planning.

UNCERTAINTIES IN ASSESSING CLIMATE CHANGE IMPACTS AND ADAPTATION IN AGRICULTURE

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Abstract

Agriculture is a managed ecosystem, which is essence in the result of interlinkages between genotype (G), environment (E) and management (M), often referred to as the G×E×M interactions. In practice both management and genotypes are adapted to local environmental conditions (both average and variability of the physical, chemical and biological environment). Assessments of impacts and adaptation of climate change must therefore take into consideration how climate change affect other environmental conditions and how these through interactions with genotypes and management impacts on crop productivity and the other services that agriculture contributes to. This in itself is a complex task; however, in addition agriculture is influenced by socioeconomic drivers and by local and governmental regulations related to issues such as food safety and environmental sustainability.

Any assessment of climate change impacts and adaptation in agriculture must therefore not only consider the direct effects of climate change on crops and livestock, but also the effects on adaptation at field, farm and regional scales (Olesen et al., 2011) and the effects of other drivers within society, such as the need for bioenergy (Dalgaard et al., 2011) and the technological changes affecting agricultural productivity (Ewert et al., 2005). This means that scenario uncertainty adds to uncertainties associated with quantifying impacts and adaptation.

Since agroecosystems involve complex interactions between physical, chemical and biological processes as well as human interventions, dynamic crop-climate models that incorporate these processes have often been used to simulate the impacts of climate change, and they have also been used to address some adaptation options. However, most of these models have not been revised recently and do not necessarily represent current knowledge (Rötter et al., 2011). Also different models may provide different answers, and use of multi-model ap-

proaches may be a better option (Palosuo et al., 2011) that will also allow quantification of some of the model uncertainty. However, there are also other approaches for quantifying impacts of climate change on agroecosystems, such as development of empirical models based on mining of large datasets (Kristensen et al., 2011) or the use of space for time analogues (Olesen et al., 2011). Future studies in this area should apply a range of different approaches and compare these with the aim of better understanding uncertainties as well as opportunities for adaptation that will minimise costs of climate change for both farmers and the society.

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UNCERTAINTIES IN **AGRICULTURE IMPACT STUDIES** UNDER CLIMATE CHANGE

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Abstract

Addressing uncertainty is extremely important due to its practical application; it can be used for decision support and cost calculations of impacts and adaptation measurements to climate change. As the relevance of uncertainty permeates scientific community, (1) the uncertainty magnitude will increase as a result of the quantification of new sources. (2) Secondly, the bridges connecting source-nature-behaviour will be described. Once this degree of knowledge is reached, (3) proper modelling will efficiently manage uncertainty reducing its presence in impact prediction by avoiding unnecessary ones.

Regarding the first point, currently it is not possible to measure uncertainty in all its magnitude. The ultimate cases of uncertainty inaccuracies are the assumptions and simplifications necessary to reduce complexity and computational demands. Therefore this thesis in a first sub-project (Probabilities in wheat yield for 2020 and 2050 in Denmark) aims to come up with a framework to study the different sources of uncertainty separately and translate them to probability measurements. Apart from climate uncertainties, impact predictions in agriculture are overshadowed by model inadequacy, parameter uncertainty and measurement error (in order of importance) (Refsgaard et al., 2011). Future yield in terms of probability has been already solved theoretically, but there seems to be a barrier for its practical use. This theoretical framework does not completely connect with current methodologies of uncertainty analysis such as Bayesian Calibration or Bayesian Model Comparison (BMC) techniques.

The thesis also aims to introduce the second point within two further sub-projects: "Variations of uncertainties with scale" and "Model inadequacy development with time".

This point (bridges connecting source-nature-behaviour) has to do with the variation of uncertainty from one study to another. Uncertainty is related to model complexity. Model complexity is in turn related to scale (Challinor and Wheeler, 2008; Tubellio and Ewert 2002; Challinor et al., 2009). Simple models seem to be prepared for bigger scales and more complex models for lower ones. More complex models need more data to avoid over-parameterization phenomena. This shows that there is a triangle of interactions between model complexity-scale-data that should be studied in order to find the optimum in given study (Challinor et al., 2009). This optimum can be defined as the point in which uncertainty efficiency is at its maximum.

Apart from the evolution of uncertainty with scale, it is also worth to consider the uncertainty development with time. For a given scale and data set, the uncertainty in complex models can be larger compared to simple models. On the one hand, the parameter uncertainty is supposed to be larger and uncertainty propagates faster through the equitation system of the complex models. On the other hand, as models in climate change impact studies are pushed to their limits; complex model may remain more stable. In other words, in complex models uncertainty evolves slower with time (as climate changes). This can lead to the hypothesis that in some point, for long term studies, more complex models are required independently of the scale.

The first sub-project is linked to the future climate. Time and scale variations of uncertainty point to uncertainty behaviour working with current climate data. Analysing this behaviour can help to build up the basis for improving uncertainty efficiency.

HARMONIZED MODELLING OF **NUTRIENT EMISSIONS** INTO AND LOADS IN EUROPEAN RIVER SYSTEMS

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Abstract

According to the current state of knowledge there is a lack of models with a harmonized approach to calculate nutrient emissions into and loads in transnational river systems and to consider measure implementation, respectively. The challenge of an Europe-wide policy aiming at the development and implementation of river basins management plans can only be faced with large-scale spatial modelling. For this on the one hand detailed country data, on the other a harmonized view on different river basin scales have to be taken into account.

To meet these necessities we applied the model MONE-RIS (MOdelling Nutrient Emissions in RIver Systems) at the European-scale. MONERIS is a semi-empirical, conceptual model to calculate nitrogen and phosphorus emissions into surface waters, in-stream retention, and resulting loads on a river catchment scale (Behrendt et al., 2000, Venohr et al., 2009 & submitted). With the implemented scenario manager the effect of measures on the nutrient loads in rivers can be determined. The model results allow a comprehensive, large-scale assessment of nutrient emissions into and loads in river systems as basis of decision-making regarding to the EC Water Framework Directive. They could support across border cooperation to develop specific management options and coherent management plans for European rivers basins.

For the Europe-wide MONERIS calculation a harmonized data base with freely available data from, for instance,

European agencies (EEA, JRC, Eurostat) or international associations (FAO, OECD) was prepared. Calculations were done for nearly 2,000 hydrological sub-catchments with a mean size of 2,800 km² covering EU 27, Norway, Switzerland and Balkan States. Based on the results of the EU-wide application different scenarios were calculated to assess the effect of measures to reduce nutrient emissions such as scenarios for the use of phosphate-free laundry and dishwasher detergents, changes in land-use intensities and the fulfilment of the target values of the EC Urban Waste Water Treatment Directive.

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ENVIRONMENTAL AND ECONOMIC EFFECTS OF REGULATING PHOSPHORUS USE AND LOSSES FROM THE AGRICULTURAL SECTOR – AN EMPIRIC STUDY

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Abstract

In an earlier paper (Hansen & Hansen, forthcoming); we analyzed the farmers profit function coupled to the phosphorus system in agricultural soils. This implies that the farmer include phosphorus in feed in his profit function and implicitly phosphorus in manure. In addition is the stock of phosphorus accumulated in the agricultural soil over time included in the social welfare function due to the different loss ways which releases phosphorus to the water ecosystem. Phosphorus can be lost directly to the water ecosystem when it is applied through chemical fertilizer or manure. Or it can be lost through soil erosion or surface run-off which both depends on the phosphorus stock capacity in the soil. The model is dynamic because the phosphorus stock changes over time which means that there is a time lag between phosphorus application and phosphorus losses to the water ecosystem.

In this paper we run the model using empirical data from a Danish case study area. Several studies before aim to model phosphorus losses in combination with farmer profit

maximization (eg. Helin et al. 2006, Goetz and Zilberman 2000). But the new in this empirical study is the focus on intensive animal husbandry farms that produce a phosphorus rich waste product (manure) and therefore have no incentive to reduce their application of phosphorus to the field. We analyze the effect of implementing a tax on phosphorus surplus and what happens if we supplement with subsidies for measures to reduce erosion and/or a manure reallocation scheme.

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SCIENTISTS AND STAKEHOLDERS WORKING TOGETHER ON **LAND USE MODELLING** AT THE REGIONAL SCALE: AN INPUT TO **URBAN SUSTAINABLE INDICATORS** FOR EUROPE

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Abstract

In the context of the current global recession, key concerns include rising unemployment, increased population flows and increased landscape degradation. The development of solutions to real world environmental and land use management problems is becoming increasingly urgent and requires that scientists and stakeholders/policy-makers exchange knowledge and experience.

Within Europe, Ireland is experiencing one of the severest recessions. It has undergone substantial changes over the past three decades: recession in the 1980s, boom in the 1990s and economic collapse at the end of the 2000s (Bartley and Kitchin, 2007). Over these periods there have been substantial land use changes and population variation (Williams et al., 2007). The paper investigates the Greater Dublin Region of Ireland where urban development has been intensive and poorly controlled, leading to changes in its spatial configuration and particularly the preponderance of a sprawl type pattern of development. Scientists and stakeholders/policy-makers during a summer school and workshop in 2009 took a closer look at four land uses in County Dublin: residential (continuous and sparse), industrial, commercial and services using

a scenarios approach, combined with the urban and regional MOLAND model. Land use maps framed by the land use and regional planning policies were produced and meaningful indicators were selected to improve the existing MOLAND indicators of urban sustainability, land use and environmental performance and applied at a regional scale.

These initial results provide a platform for a methodology to be used by the two communities, scientists and stakeholders/policy-makers, to ensure effective further collaborations (Fig. 1). The four scenarios devised and implemented and the associated set of indicators calculated allow us to grasp crucial ideas about urban development processes, sustainable growth management and their possible consequences in the regional context of Europe and also worldwide.

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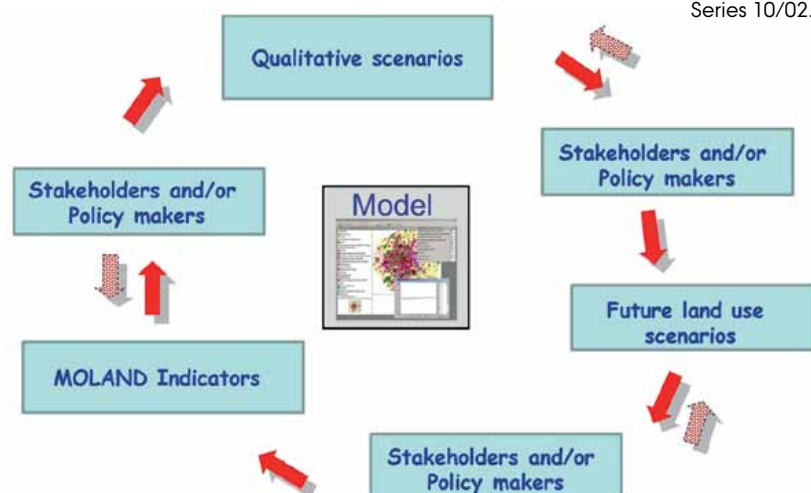


Figure
Scientists and stakeholders
interacting actively

THE SCIENCE-POLICY DISCONNECT: **LANGUAGE ISSUES** AT THE **SCIENCE-POLICY** BOUNDARY

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Abstract

The language barrier between science and policy is as large and often underestimated as that between British and American English. Although most of the words are the same, they often carry different meaning. One good example of this is the term 'theory,' which has caused much trouble for policymakers regarding school curricula on evolution. However, there are many other words that have one specific meaning when used by scientists and another more common meaning in everyday use. Translation difficulties may also arise from the particular phraseology and writing conventions used by scientists. These are often more subtle, but they can create just as much, if

not more, trouble in the sound-bite world of mass media, especially in high-profile subject areas such as the effects of noise on marine mammals. Using an excerpt from a report in this subject area by the US National Research Council as a case study, the authors will provide some examples of where scientific language use can be misunderstood (and potentially even deliberately misused) by policymakers and stakeholders and offer some possible solutions to these issues. The intent is to facilitate communication between scientists and policymakers in order to improve management efforts.

IS CURRENT MANAGEMENT OF **SEMI-NATURAL ECOSYSTEMS** SHORT-SIGHTED AND LIMITED, RATHER THAN SCIENCE BASED AND HAVING A LONG **SIGHT**?

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Abstract

Heathland ecosystems is an example of protected ecosystems that are heavily managed by fire, cutting and removal of the upper soil layer. This management was developed in the Netherlands to remove nitrogen from the ecosystems to compensate for a high atmospheric nitrogen deposition originating from agriculture, industry and traffic.

The result of this management has been a much more uniform heathland landscape with a high cover of mainly common heather *Calluna vulgaris*. Besides having the effect that the diversity known from old heathland landscapes, the result has been that very few species thrive in these ecosystems.

The big question is then: Should we change management to make it more diverse, leaving a more mosaic like heathland landscape for the biodiversity? Or is it the manage-

ment and the way it is carried out that is the problem?

Current management successfully removes excess nitrogen, which is important for the ecosystem. However, with the removal of live and dead biomass as well as the upper morlayer, base cations and deposited clay particles are also removed from the ecosystem. In many heathland these management measures are repeated with 10 – 20 year intervals or shorter. In the long term such repeated management may be problematic and in ecosystems with a low ability to buffer acidifying deposition such as heathlands, sulphur deposition and biomass removal may in the long result in massive acidification of the upper soil layers, with dramatic impact on ecosystem engineers and accompanying biodiversity.

Science based alternatives to current heathland management methods are suggested and discussed based on natural soil and vegetation development.

MANAGEMENT OF DANISH INLAND WET HEATHLAND

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Abstract

Nutrient poor dwarf shrub dominated ecosystems such as heathlands and ombrotrophic bogs are considered sensitive to nitrogen deposition due to the ability of nitrogen to increase the growth of competitive grasses such as *Deschampsia flexuosa* and *Molinia coerulea*. Both species have been reported to outcompete *Calluna vulgaris* in dry heathlands and the latter to outcompete *Erica tetralix* in wet heathland. Here we report investigations of observed disappearance of *Erica tetralix* from inland wet heathland in Denmark that can not be explained by competition.

The investigations included vegetation analysis and soil chemistry along two line-transects on the location "Borris Hede". Presence of purple moor grass *Molinia coerulea*

and Common heather *Calluna vulgaris* were substantial in the former *Erica tetralix* dominated areas. The measurement of the C/N ratio in the morlayer showed a ratio of 21 – 26 in the morlayer under the *Erica tetralix*-stands, whereas the ratio in a healthy ecosystem would be around 30. pH generally was between 3.0 and 3.5. On this background possibilities for ecosystem management are discussed.

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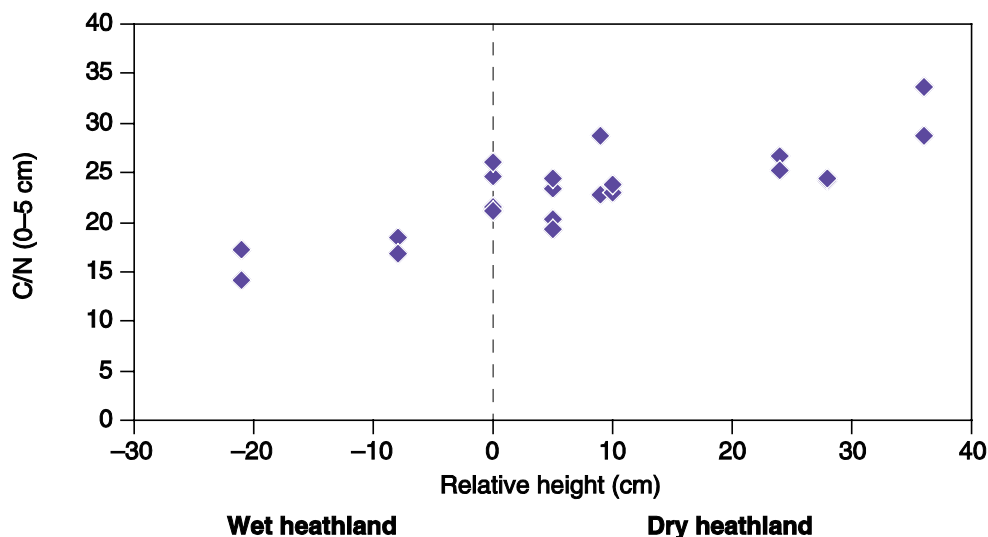


Figure 1. The ratio between the C and N in the morlayer (0-5 cm) in the transect investigated at the Borris shooting range. The relative height is measured with X-axis zero as the point where *Erica tetralix* had its maximum cover.

COMPETITIVE INTERACTIONS OF *CALLUNA VULGARIS* AND *DESCHAMPSIA FLEXUOSA* IN DRY HEATHLANDS

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Abstract

A novel method for measuring plant-plant interactions in natural and semi-natural plant communities, where it is difficult to distinguish individual plants, is presented. It is assumed that the ecological success of different plant species in the plant community may be measured by plant cover and vertical density (a measure that is correlated to the 3-dimensional space occupancy and biomass). Both plant cover and vertical density are measured in a standard pin-point analysis in the beginning and at the end of the growing season and modelled in a state-space model.

The presented method allows direct measurements of the competitive effects of neighbouring plants on plant performance and the estimation of parameters that describe the ecological processes of plant-plant interactions during the growing season as well as the process of survival and recruitment between growing seasons.

The method was applied on a dry heathland plot dominated by *Calluna vulgaris* and *Deschampsia flexuosa*. Significant competitive interactions were demonstrated among the two species and using the model it was possible to predict the expected community dynamics in dry heathlands. The predicted plant community dynamics were compared to the observed plant community structure in 5000 Danish dry heathland plots.

The presented method is suited for testing different ecological hypotheses on competitive interaction along environmental gradients, investigating the importance of competition, as well as predicting different ecological scenarios. Furthermore, the method allows a meaningful investigation of the plant-plant interactions in plant communities that are dominated by perennial species of variable size and where it is difficult to distinguish individual plants, e.g. most grassland ecosystems.

HOW TO PROMOTE **GREEN INDUSTRIES?**

EMISSION TRADING, SUBSIDIES AND INNOVATION

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Abstract

Individual countries may have a rational economic interest in creating comparative advantages for green industries in order to capitalise on their first-mover advantages in these industries. A small country like Denmark, for example, is one of the leading countries in the attempt to promote green industries such as the wind turbine industry. Why does e.g. Denmark act in this way? This question has not yet been dealt with in the literature. One rational explanation could be that besides the relatively strong environmental consciousness in Denmark, we observe that Denmark is a leading producer of the green technologies that are needed both within the wind turbine industry and other sustainable industries for reducing carbon. Therefore,

global agreements and efforts to further reduce carbon would lead to higher exports from Denmark and the EU to other regions of the world. Given that politicians, such as those in the case of Denmark, want to achieve specific CO₂ target levels by the use of green industries, I investigate how the European Emission Trading System for CO₂ trade may be combined with subsidies. Such policy initiative may enhance both an early switch in time from high to low carbon production and more innovation. These policy implications from theory are in perspective discussed in relation to future climate policy where emission trading and innovation are to play a key role.

ASSESSMENT OF **HEALTH-COST** EXTERNALITIES OF **AIR POLLUTION** IN DENMARK AND EUROPE USING THE EVA MODEL SYSTEM

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Abstract

Air pollution has significant negative impacts on human health and well-being, which entail substantial economic consequences. We have developed an integrated model system, EVA (Economic Valuation of Air pollution), based on the impact-pathway chain, to assess the health-related economic externalities of air pollution; in particular, the EVA system can be used to estimate the external costs resulting from specific emission sources or sectors. Such estimates can be used to support policy-making with respect to emission control. Key to the EVA system is that it employs more accurate yet computationally demanding methods in each part of the impact-pathway chain, relative to comparable modelling systems. Furthermore, we have developed a tagging method able to calculate the contribution from a specific emission source or sector to overall air pollution levels. In this study, we apply the EVA system to Europe, with a more detailed analysis of health impacts in Denmark.

The first objective of this work is to test the EVA system. This is done by simulating a number of realistic and relevant scenarios with the purpose of finding the anthropogenic activities and emission sources in and around Denmark that have the largest impact on human health. This involves evaluating the contributions of all significant emission sectors in Denmark that may impact on human health, as represented by the 10 major SNAP (Selected Nomenclature for Sources of Air Pollution) categories, as well as all emission sectors simultaneously.

We also assess the external costs from international ship traffic, since this sector is an important contributor to air pollution within Denmark as well as in Europe. Special attention has been paid to international ship traffic in the Baltic and North Seas, since these waters border Denmark and special regulatory actions on sulphur emissions have

been introduced in these areas. Furthermore, we assess the health-related external costs from the total air pollution levels in Europe (including both natural and anthropogenic sources), and these results are compared to similar results obtained in the Clean Air For Europe (CAFE) project. The scenarios represent the years 2000, 2007, 2011 and 2020, and are given both for Denmark and Europe.

We conclude that despite regulatory action in Europe in recent decades air pollution still constitutes a serious problem to human health, and that the related external costs are considerable. The main Danish emission sectors contributing to health-related external costs in Denmark are: agriculture, road traffic, domestic heating (including wood stoves), other mobile sources and power plants. We estimate that emissions from international ship traffic are responsible for health-related external costs in Europe of 58 bn Euros/year in the year 2000, increasing to 64 bn Euros/year in the year 2020. The number of premature deaths in Europe due to international ship traffic is estimated to be around 50,000 cases per year, and increasing in spite of the introduction of the sulphur emission control area (SECA). The total health-related external costs for the whole of Europe is estimated at 803 bn Euro/year for the year 2000, decreasing to 537 bn Euro/year in the year 2020. We estimate the total number of premature deaths in Europe in the year 2000 due to air pollution to around 680,000/year, decreasing to approximately 450,000 in the year 2020.

The present study is a part of the research of the Center for Energy, Environment and Health (CEEH), financed by The Danish Strategic Research Program on Sustainable Energy under contract no 2104-06-0027. Homepage: www.cee.dk

EVALUATION OF **SOIL ECOSYSTEM HEALTH** AND SERVICES ACCORDING TO **SUSTAINABILITY** THRESHOLDS FOR **INDUSTRY** IMPACTS

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Abstract

An existing framework for evaluating soil ecosystem health and services (Thomsen et al., 2011) is tested by use of ERICA for quantifying indicators susceptible to chemical stressors. ERICA (Environmental Health Index for a Chemical Assessment) (Boriani et al. 2010) provides clear information to regulators and population about the possible hazards in a site and the relative effects on the ecosystem and human health status.

ERICA presents a strong scientific derived chemical index covering main environmental compartments, which makes it possible to evaluate sink-source patterns in the outer environment.

ERICA may not only evaluate soil ecosystem health, but also the indirect industry impact on human health within the built area land use scenarios.

New indicators for cumulative impacts of identified risk cluster are tested in synergy with an improved index for quantifying bioavailability.

The presentation put focus on the improvement of ERICA instrument to measure the indirect industry impact on human health proposing an integrated risk assessment approach to measure the impact of the policy and procedures adopted by the companies to quantify suitability of land use, i.e. soil ecosystem health and services. A dedicated instrument for the industry to measure their emissions impact on ecosystem and human health and, i.e., the need for soil ecosystem health management by means of soil health improving intervention strategies is presented.

Regarding soil ecosystem health, inputs from the planned EU soil directive (EU Directive 2006), will be taken into account in the entire framework as a regulatory strategy to be followed and the cut off thresholds will be analyzed within the new indicators

Regarding human health aspects within built up areas, ERICA allows focusing the critical routes of human exposure according to the ecosystem services provided considering suitability for land use with respect to vulnerable population groups.

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BIODIVERSITY OVER THE HORIZON: MODELLING THE DISTRIBUTION AND ABUNDANCE OF **MARINE WATERBIRDS** IN THE INNER DANISH WATERS

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Abstract

The shallow marine waters around Denmark support globally significant aggregations of divers, seaducks and alcids in winter. Complete aerial survey of marine waterbirds in the Inner Danish Waters was achieved for the first time in 2008. Data from line transects were subjected to distance sampling and spatial modelling techniques to generate density surfaces and total population estimates for the entire area, equating to over one million individuals from the seven most numerous species. These density surfaces showed very few diversity “hot-spots”, because key species showed conspicuously mutually exclusive distributions, probably due to their contrasting feeding ecology. The network of European Union Special Protection Areas and Ramsar Wetlands of International Importance in the Inner Danish Waters was mostly designated in 1983 to protect the most important areas of water for these species. The boundaries of the existing site-safeguard network coin-

cided well with the highest densities of marine waterbirds found in the survey 25 years later for all species except the alcids. Total species abundance estimates differed from earlier surveys in 1968-73 (Joensen 1974) and 1988 (Laursen et al. 1997) between species, but differences in survey area and techniques between surveys and large variation in between-year avian abundance precludes firm conclusions about long-term trends in abundance. However, Long-tailed Ducks do seem to have declined in Danish waters in parallel with trends witnessed in the rest of the Baltic.

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USEFUL **TOOLS** FOR ASSESSING **CONSERVATION TARGETS** AND IMPACTS ON **MARINE HABITATS** – EXAMPLES OF WATERBIRD POPULATIONS AND MARINE INFRASTRUCTURES

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Abstract

Offshore infrastructures, particularly wind farms, are being planned and built with an ever-increasing pace. To be able to estimate potential impacts of these strategic plans on protected areas and ecosystems in general we need to be able to describe processes and patterns of target populations and communities at different scales. A pre-requisite for sustainable spatial planning is that we can estimate the distributions and size of target populations for marine conservation as well as the carrying capacity of their habitats. We show examples of tools capable of “tackling” these challenges in relation to the conservation and management of waterbirds in Danish waters. By using species distribution models (SDMs) it is possible to describe relationships between observed species and a range of different dynamic and static environmental variables reflecting the geophysical and biological environment as well as anthropogenic disturbance. This approach allows us to estimate population sizes and habitat displacement

at a high resolution. We use two-part Generalised Additive Models (GAMs) to analyse data sets displaying zero inflation (an excess of zeros), spatial and temporal autocorrelation and non-linearity. We show successful applications based on both survey and telemetry data. We further show an application of individual-based modelling (IBM) for defining the carrying capacity of waterbird habitats and for predicting changes in species fitness following habitat alteration. IBMs relate individual behaviours such as feeding activity and food intake rates to environmental factors and allow assessment of the factors constraining species fitness. By using IBMs we can for example predict whether reduction in food resources will result in negative effects on bird survival. By using a combination of SDMs and IBMs we are able to generalise complex systems which makes an assessment of conservation targets and environmental impacts possible at different scales.

MANAGEMENT INSTRUMENTS FOR NATURA 2000 AREAS; USE OR MODIFY THE OLD OR DEVELOP SOMETHING NEW ?

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Abstract

The Habitats Directive gives Member States considerable freedom in how to arrange the management of the Natura 2000 areas – through 'appropriate management plans specifically designed for the site or integrated into other development plans and appropriate statutory, administrative or contractual measures'. Given the freedom in implementation it can be expected that domestic factors and existing repertoire of institutional procedures, technologies and organisational forms (Lenschow et al, 2005) have a considerable impact on the ways countries choose to arrange the management. So which instruments (e.g. management plans, contractual arrangements, hunting plans forestry plans, regulations) did they choose and how much were they modified in order to address the requirements of Natura 2000?

The presentation will show that the obligation to arrange the management of N2000 areas by MS leads to 3 types of responses;

- Using the old: existing policy instruments are used without much adaptation. The analysis shows that several countries indeed tend to use the pre-existing instruments for addressing the management of Natura 2000 areas.
- Filling the gaps: apparently the pre-existing policy instruments are only partly capable of addressing the new management challenge of 'Natura 2000'. Therefore additional instruments are developed which are used parallel to pre-existing ones..

- Developing the new: The Habitats Directive also leads to the development of new instruments in some EU Member States.

(Kruk et al, 2010; Bouwma et al, 2010)

However there is no preference for one of the three types amongst the EU Member States. In the presentation a reflection will be given on the reasons for the different choices of Member States and what the possible implications are of choosing one of the 3 identified responses.

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USE OF ENVIRONMENTAL BENEFITS IN POLICY DECISION PROCESS

Thomas Thaler; Flood Hazard Research Centre (FHRC), Middlesex University, United Kingdom

Abstract

This presentation shows how various European countries deal with environmental benefits in policy decision process. Environmental issues are an increasing concern for the EU. This raised awareness requires improved decision-making by all levels of government and by the general community. Several EU legislations such as the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD), but also national climate change mitigation measures as well as air quality improvement and other environmental measures, explicitly acknowledge the importance of environmental benefits and costs and the need to integrate them into the policy making process. In some EU legislations, e.g. MSFD, the use of environmental benefits in the implementation of the directive are required. This applies to direct benefits as well as to wider environmental benefits and co-benefits. The role of environmental benefits and costs in policy making must be reassessed as many environmental and resource management decisions become more and more prominent. There is an increased call for scientific based evidence when implementing environmental legislation. Moreover, growing competition for financial resources requires a more precise look at the different environmental co-benefits that certain environmental policies bring. In particular, larger ecological scales which are affected by

policy making become much more difficult to characterise because there is often a focus on the system rather than on individual species or on specific environmental issues. There are several methods to assess environmental benefits but their application in policy making varies widely across Europe. This presentation shows how different European Member States deal with the aspect of environmental benefits in the national environmental policy, focusing especially on their main barriers and key drivers. The study assesses European countries in order to analyse the use and non-use of environmental benefits in policy decision process.

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THE ROLE OF TIME SCALE IN ASSESSING EXTERNAL COSTS OF METAL EMISSIONS

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Abstract

Monetary evaluation of emissions is a fundamental component of a decision support tools like Cost-Benefit Analysis –CBA (Boardman A.E. et al., 2006). However, the results of such assessment are subject to high uncertainties partly dependent on the setting of space and time scale conditions in the modelling phase. This study focuses on the differences in keeping a short-term vs. long-term perspective in the analysis, where human biokinetic and environmental dispersion models (like e.g. Pounds and Leggett, 1998; Olesen et al., 2007) are used trans-disciplinarily inside the ExternE methodology framework (European Commission, 2004). Two case studies are taken as a starting point for a discussion on how such approach can be used for evidence-based decision making. In particular, two policy instruments are opposed: the implementation of air pollution control devices (APCD) on stack gases versus the remediation of contaminated soil, as both are possible measures for mitigation of lead (Pb) exposure-related impacts on human health (Pizzol et al., 2010a; Pizzol et al., 2010b). In the presented study, the total costs due to metal dispersion, accumulation, and exposure are quantified in different time scales, and different discount scenarios are analysed. Preliminary results show that, while in the short-term costs via the inhalation exposure route constitute the biggest share of the total costs, on the long-term they will become comparable to costs via ingestion. However,

the application of a positive discount rate is expected to reduce the costs via ingestion that are due to cumulative exposure and are therefore occurring mainly in the future. Therefore, the choice of the time scale can influence significantly the outcome of the evaluation and consequently bias its application in decision making.

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WORKSHOPS

Workshops will be interactive sessions. An introductory perspective and case studies from invited speakers will lead into a structured discussion of relevant issues, facilitated by the conference organisers.

WORKSHOP 1

DATA COLLECTION AND DATA STRATEGY

Good information and reliable data sources are central to adequately monitor and interpret trends and effects in relation to environmental variables. But how can you define the data need and collect data strategically to support regulatory purposes? What are the potential synergies, and what are the challenges when collecting data for multiple purposes? Or – alternatively – combining datasets obtained in different projects? What is the uncertainty related to the methods used for collecting data? In Denmark the state is the primary partner in the national monitoring, however the municipalities also take initiatives in terms of monitoring e.g. with the purpose of providing data for biodiversity targets. Furthermore there is a need for evidence based nature management. The basis for the decisions taken in the municipalities – outside the National monitoring programme – in many cases needs qualification.

All over EU, citizen observatory is playing an increasing role in public monitoring strategies, but how does this affect the quality and uncertainty of the data? What are the implications for the scientific and regulatory use of the data? What is an optimal strategy for monitoring? How can the monitoring activities be standardised, e.g. in terms of methods? – and to what extent is this necessary?

In this workshop you will get a good insight on important do's and don't's if you are planning new data collection. It will also give good background knowledge for people working with management tools based on only a few measurements.

WORKSHOP 2

EVIDENCE BASED NATURE MANAGEMENT

For many years it has been clear that a gap exists between research and nature management. On one hand, findings of research studies are rarely translated into actual management practice. On the other hand, large restoration projects have been implemented without a proper monitoring program that could have been used to provide new insights into what works, how well and at what cost. There is no doubt that this has resulted in a suboptimal treatment of many areas and that the limited funds for nature management could have been used better and more effectively.

Danish habitats and species are protected and managed under national as well as EU-legislation. The Habitats Directive, for example, consists of the Natura 2000 network of protected sites and a system for the protection of species and habitat types. In total the Directive protects more than 1.000 animal and plant species and 200 types of forests, meadows, wetlands, etc., which are of European

importance and of special interest. The actual implementation of the Directive and interaction with national legislation, however, is not straightforward and should be based on the best possible knowledge and know-how. This workshop aims at bridging the gap between research and practice and a number of relevant issues could be discussed such as: How do we define favorable conservation status and minimum viable population size? How do we ensure that restoration projects provide data for scientific research? How do we prioritize funding for nature conservation and resolve conflicts between the different Directives, national legislation and various stakeholder interests?

This workshop is for anybody interested in science-based nature conservation and the link between basic research, applied research and management. Discussions will be based on concrete nature restoration projects presented at the workshop.

WORKSHOP 3

NATURE MANAGEMENT IN A CLIMATE PERSPECTIVE

Predicted climate change, land subsidence through drainage of organic soils and rehabilitation of an increased land-water connectivity will all cause increased flooding of riparian areas and floodplains. This raises a number of questions:

- Are vulnerable nature types in the floodplain endangered by the increased flooding of often nutrient rich stream water and how can these potentially negative impacts be mitigated?
- Would the increased flooding increase nutrient retention or is erosion likely to outweigh the positive effects of deposition?
- How should we address the risk of increased flooding to human safety and livelihood of local farming communities?

This workshop is for managers tackling complex wetland management problems where there are potential conflicts between water and nature management.

WORKSHOP 4

THE **BATTLE FOR LAND** – MANAGING FOR MULTIPLE OUTPUTS: CONFLICTING **FRAMEWORKS**, CONFLICTING **REQUIREMENTS**?

Land is a scarce resource. Land use and land management decisions must therefore be considered carefully if they are to deliver the best set of outcomes. River valleys, for example, produce a wide variety of different outputs from different types of land uses – wetlands, buffer zones for rainwater filtration, river restoration, nature reserves for endangered species, agricultural production, bio energy production etc. Some of these interests make conflicting demand on land management priorities. How should you decide which land management and land use to recommend for any particular location? You are faced with these challenging decisions in your everyday work.

This workshop will provide an insight into practical application of cost benefit analysis and the ecosystem services approach – two frameworks which can be used to inform policy and decision making regarding tradeoffs

between alternative land uses. What potentials do these approaches offer currently and what challenges could arise from their broader application? Cost benefit analysis (CBA) will be required for the next water planning cycle under the Water Framework Directive. Which potential benefits can CBA evaluate currently and which benefits are still missing? The ecosystem services approach aims to extend CBA to cover the full suite of outputs. How is the ecosystem services approach being used currently to inform policy making and land management decisions? Is this approach feasible in practice at national, regional and local scales?

This workshop aims to inform about these issues and provide a forum for debate and discussion amongst land management practitioners and academics.

WORKSHOP 5

TOOLS FOR MANAGERS – NEW DEVELOPMENTS AND FUTURE DIRECTIONS

This workshop will focus on how to bring the right information to decision-makers, introducing a number of new tools and discuss their applicability in future management scenarios. These tools will include risk mapping of nutrient loss from catchments, a decision support system (DSS) used in water management of the Nile basin and a DSS including climate change scenarios in water management. The tools will be demonstrated on specific cases to illustrate their capabilities and participants are encouraged to bring and introduce any tools or methods that

might be relevant in the context of the workshop. In addition to the knowledge exchange on tools and methods, the outcome will also be an identification of end-user needs and an outline of possible future directions.

This workshop will give inspiration and hands-on experience on new tools for environmental managers and practitioners as well as an opportunity to influence the scientific development of future tools.

BIO-ENGINEERING IN THE BALTIC SEA – VALUE OF WATER QUALITY IMPROVEMENTS & RISK PERCEPTIONS

Marianne Zandersen; Dr., Department of Environmental Science, Aarhus University

Abstract

The Baltic Sea is heavily eutrofied and the trend has gone from bad to worse. The hypoxic zone has increased about 4-times since the 1960s and about 17% of the bottom area of the Baltic Proper was affected by anoxia (oxygen free, with toxic hydrogen sulphide present) in September-October 2010 and has caused severe ecosystem disturbance. Despite political agreements and actual reductions in nutrient emissions to the Baltic Sea, the prevalence of oxygen depleted areas has not decreased. Two pilot projects in Sweden and Finland investigate the effects of oxygenation pumping in coastal and deepwater areas (PROPPEN and BOX projects, respectively).

Oxygenation pumping moves oxygen rich water from the higher levels of the water column to the bottom waters/ deepwater. The expected effects include a slowing down of the sediment release from the bottom and improvement of the possibilities for aerobic bacterial decomposition and over time for the establishment of fauna. The projects test a bio-engineered approach to speeding up the recovery of the Baltic Sea such that the sea could be unaffected by eutrofication sooner than without oxygenation pumping.

We undertake a representative primary survey of the populations in Sweden, Finland and Lithuania in order to assess the preferences of the population around the Baltic Sea towards such an engineered approach and the related potential ecological risks. The survey covers two topics:

- A contingent valuation of the willingness to pay for a speedier recovery of the Baltic Sea; and
- A risk perception survey using Likert scale questions based on two different scenarios of risk.

Using the New Environmental Paradigm (NEP) set of questions, we aim to ascertain the reasons and motivations behind people's preferences.

Preliminary results show willingness to pay ranging from 24Euro in Lithuania to 65Eur in Sweden per year per household for a faster improvement of water quality through oxygenation pumping. Also, respondents appear to respond rationally towards different levels of risks and different scales of oxygenation pumping.



Oxygenation pumping in open sea powered by windmills (conceptual stage).



Coastal site test pump (applied in practice).

INTEGRATED MODELLING TO SUPPORT COST-EFFECTIVE MANAGEMENT OF NUTRIENT REDUCTIONS TO THE BALTIC SEA

Hasler B¹., M. Czajkowski, K.Elofsson, J.C.R. Smart, A. Waas, M. Konrad, Andersen H.E., G. B. Mathiesen, H. Thodsen, C. Göke, M. Mörrth, E. Smedberg, C. Humborg

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Abstract

Abatement and mitigation of nutrient loads to the Baltic Sea are two central aims of HELCOM's Baltic Sea Action Plan (BSAP) as well as being required by the Water Framework Directive and the Marine Strategy Framework Directive. As part of the Baltic Nest Institute and the RECOCA project (a BONUS + project), integrated cost-minimisation models have been developed to identify cost-effective methods and measures for reducing nutrient loads to the Baltic. Two separate cost-minimisation models, 'BALTCOST' and 'RECOCA', have been developed. Both of these models identify minimum cost combinations of measures to fulfill load reduction targets for the Baltic, and both models include abatement measures in the agricultural, energy and transport sectors together with wetland restoration and wastewater treatment. Emissions to both air and water are thus included in the cost-minimisation.

The BALTCOST and RECOCA models differ in their spatial resolutions. BALTCOST models 9 countries and 24 drainage basins around the Baltic, whereas RECOCA covers the same 9 countries, but at a much higher spatial resolution of 10x10 km grid cells. Special attention is paid to the retention and transport of nutrients from agricultural and wastewater sources through rivers and lakes to the sea, and also air-borne transport of emissions from energy, transportation and agriculture.

The spatially disaggregated RECOCA model has been carefully constructed to allow us to explore how spatial differences in the effect of nutrient load reductions, retention and costs influence the cost-effective distribution of measures for achieving load reduction targets. Model development required interdisciplinary cooperation between economists, hydrologists, catchment modellers and

NANI-analysts. Development of the RECOCA model has been heavily dependent on the integration of detailed and consistent physical results from e.g. DAISY and NANI models with data on economic costs and returns from e.g. fertiliser application and crop yields in order to identify cost-effective abatement measures at specific spatial locations. In addition, the best available economic data from FAO, EUROSTAT and national data sources have been used to estimate cost-functions for the various measures at country or drainage basin level.

The BALTCOST model is well suited to large scale scenario modelling of cost-effective combinations of measures to meet nutrient load reduction targets for the different Baltic sea regions (7 regions in all), while the RECOCA model is well suited to address cost-effective spatial allocation of these measures within countries and regions. The two models provide the opportunity to produce well grounded implementation recommendations at different spatial resolutions to support governance and management of the Baltic Sea at different spatial scales. Preliminary results will be presented for the cost-effectiveness of load reduction scenarios, together with a brief description of the data and assumptions used in model development.

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A TRANSLOG APPROACH FOR ESTIMATING THE **COSTS** OF IMPROVING **WASTE WATER TREATMENT** IN CATCHMENTS DRAINING INTO THE BALTIC SEA

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Abstract

Enhanced waste water treatment (WWT) will play a major role in meeting the Baltic Sea Action Plan (BSAP) targets for improving water quality in the Baltic Sea by 2021. Improved WWT therefore features as an important emissions reduction measure in catchment-scale models such as BALTCOST which aim to identify cost-minimised, spatially-specific implementations of emissions reduction measures around the Baltic (Hasler et al 2011). Reliable location-specific estimates of average and marginal abatement costs are central to the validity of these cost-minimisation models.

To date, it has proved difficult to obtain country- and catchment-specific estimates of both the potential for improving WWT and the costs which would be incurred in implementing these improvements (Schou et al 2006, Gren 2008, Elofsson 2010). Here we use a translog approach (Christensen & Greene 1976, Caves et al 1981) to estimate total, average and marginal cost functions for tertiary-level WWT from a panel of firm-level WWT cost data from Denmark. The estimated translog cost function is found to be compatible with a Box-Cox form estimate of the scale response of WWT costs in Poland (Berbeka et al). In addition, the translog approach also provides estimates of the elasticities of WWT cost with respect to the prices of three key inputs: labour, energy and capital re-investment/renewals. These elasticities are applied, together with GIS-derived estimations of the percentages of local populations currently connected to WWT networks, to estimate the potential for improving WWT at particular locations around the Baltic Sea, and the costs which would be incurred in making those improvements.

Translog results indicate that WWT costs are sensitive to the scale of operation and to variations in the price of in-

puts to the WWT process. This suggests that there is likely to be considerable variation in the cost improving WWT between the various catchments which drain into the Baltic Sea. The cost-effectiveness of WWT as a measure for improving Baltic water quality is therefore likely to vary very substantially between locations when further differences in the physical retention of nitrogen and phosphorus within the different catchments are also accounted for in spatially-specific cost-minimisation models.

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COMPARING TWO SURFACE FLOW **WETLANDS** FOR REMOVAL OF **NUTRIENTS** IN AGRICULTURAL **DRAINAGE WATER**

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Abstract

In Denmark there is a growing interest for using constructed wetlands as a mean for removal of nutrients from agricultural run-off, such as drainage ditches and tile drainage systems. We have studied two surface flow constructed wetlands from district Vejle, Jutland, Denmark.

The Vicarage Wetland was constructed in 2006 and put into operation in December 2006. It is the pond type with an area of 877 m² and a volume of 200 m³. The inlet, which stems from a drainage system, consists of a small stream with wet riparian areas with an area of 1222 m² and 103 m² open water. Mean hydraulic load is 3.7 l s⁻¹ giving a mean residence time of 15 hours. The pond is densely covered with macrophytes and algae, while the riparian wetland is completely overgrown with watercress.

The Willowfarm Wetland was constructed in 2008 and put into operation in April 2008. It consists of two ponds with an area of 500 and 1485 m², respectively. In between the two ponds is a small wetland with an area of 745 m². Inlet water comes from a drainage system and mean hydraulic load is 5.7 l s⁻¹, and the volume of the ponds is 90 and 400 m³, respectively, thus giving a residence time of approximately 24 hours. The two ponds only have sparse vegetation cover, while the wetland is covered with grasses.

At the Vicarage Wetland nitrate is the dominant nitrogen species and mean concentration in inlet drainage water is

17.7 mg NO₃⁻-N l⁻¹, while concentration of total nitrogen is 17.9 mg N l⁻¹. Mean concentration of nitrate and TN at the outlet is 14.6 and 15.0 mg N l⁻¹, respectively, thus giving a reduction in concentration of 17 and 16 %. Mean concentration of phosphate, filtered TP and unfiltered TP in the inlet water is 0.029, 0.041 and 0.115 mg P l⁻¹, respectively. At the outlet the mean concentration of phosphate, filtered TP and unfiltered TP is 0.030, 0.042 and 0.082, respectively, and this reveals that there is a net retention of particulate P.

At the Willowfarm wetland the mean inlet concentration of nitrate is 11.8 mg NO₃⁻-N l⁻¹ while mean TN concentration is 12.8 mg N l⁻¹. The mean outlet concentration of nitrate shows a 17 % decrease to 9.8 mg NO₃⁻-N l⁻¹, and TN concentration decreases with 19 % to 10.5 mg N l⁻¹. Mean inlet concentration of phosphate, filtered TP and unfiltered TP is 0.033, 0.062 and 0.162 mg P l⁻¹, respectively, while mean outlet concentration of phosphate decreases to 0.015 mg P, filtered TP decreases to 0.020 mg P and unfiltered TP decreases with 75 % to 0.040 mg P l⁻¹.

The results from this study seem to indicate that constructed surface flow wetlands are able to remove nitrogen and retain phosphorus from agricultural drainage run-off although the nutrient concentrations are much lower as compared to concentrations in wastewater.

NITROGEN AND PHOSPHORUS REMOVAL IN SWEDISH AGRICULTURAL WETLANDS

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Abstract

This paper presents the Swedish experiences concerning nitrogen and phosphorus removal in wetlands constructed in agricultural catchments. Free water surface wetlands have the capacity to remove new nitrogen and phosphorus loading and can sometimes provide low-cost removal. Generally, the area specific removal rate increase with an increased load, but highly variable results are obtained when reviewing available scientific input-output data for wetlands receiving water from non-point sources. In Sweden, catchment scale analyses of the effect of wetlands have emphasized the role of wetland location for their function as nutrient traps (Arheimer and Wittgren, 2002, Tonderski et al., 2005). Recent research has focused on the use of wetlands for settling of particles with associated phosphorus, as fine particles carrying P is a major component of the phosphorus lost from agricultural fields (Ulén, 2004). The paper presents an evaluation of nitrogen and

phosphorus data series covering between 2 - 9 years in the respective wetlands with continuous flow measurements and time or flow proportional water samples for the time period covered. Those results are related to studies of phosphorus retention in wetlands using sedimentation plates. Preliminary data from eight such wetlands indicate that between 0.5 and 15 g P was retained per m² and year.

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MANY **PLANTS** ARE WANTED, BUT ARE THEY COLONIZING **CONSTRUCTED WETLANDS**?

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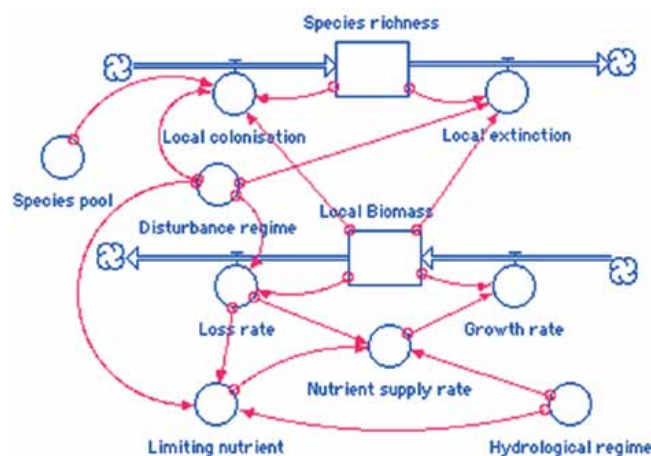
Abstract

Wetland losses over the last century have raised questions on how to stop local extinctions and restore diversity in degraded landscapes. Moreover, there is an increased awareness of how wetland plants contribute to ecosystem services and how the diversity is important for maintenance of the quality of these services. We are therefore in great need of priorities and management tools based on scientific understanding of the major ecological processes affecting the community dynamics in wetlands.

In constructed wetlands a self-design is often applied. This is based on the assumption that the plant community eventually will organize itself with appropriate species

and that only morphometrical and hydrologeochemical factors have to be considered. Hence, the outcome of the projects critically relies on the colonization process.

In this talk we will examine ecological theories and models for plant diversity and try to assess their implications and usefulness for practical work with wetlands. Using the species pool hypothesis and species dispersal characteristics, the species-area model, the species-biomass model combined with the core-satellite hypothesis, the competitive hierarchies model and the intermediate disturbance model, we will try to identify what they tell us about the most important mechanisms shaping colonization, extinction and co-existence in wetlands (Figure).



Figure

Stella model connecting the major drivers (circles) from ecological models used to analyze variations in biomass and species richness (squares) in wetlands. Rate parameters e.g. growth rate etc. appear as regulators. This model proposes the major mechanisms regulating community dynamics. It suggests important management opportunities, e.g. disturbance regimes, which may have an effect on both loss rates and on colonization rates and in turn affect nutrient limitation type.

DRAINAGE FILTERS AND CONSTRUCTED WETLANDS TO MITIGATE SITE-SPECIFIC NUTRIENT LOSSES

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Abstract

Despite substantial efforts, the leaching of nutrients from agricultural land is still a serious and costly environmental problem in Denmark and elsewhere. The quality goals of the European Water Framework Directive (WFD) for the aquatic environment require a substantial reduction of diffuse nutrient loads from farmland in Denmark. Tile drains and ditches connect fields to receiving waters and act as subsurface highways for both soluble and particulate P and nitrogen. Hence, for a large number of recipients, drainage water nutrient loads has a major impact on water quality, however, mitigation options targeting subsurface drainage are lacking. An end-of-pipe drainage filter solution offers the benefits of a targeted measure typically applied to point sources. This calls for a shift of

paradigm towards the development of new, cost-efficient technologies to mitigate site-specific nutrient losses in drainage.

A newly launched Danish research project "SUPREME-TECH" (2010-2015) (www.supreme-tech.dk) funded by the Danish Strategic Research Council, aims at providing the scientific basis for developing cost-effective filter technologies targeting P-retention and N-removal in agricultural subsurface drainage. The project studies different approaches of implementing the filter technologies including drainage well or drainage pipe filters as well as surface-flow and sub-surface flow constructed wetlands.

A NEW REGULATORY DESIGN USED BY THE EU – WITH THE PROMOTION OF RENEWABLE ENERGY AS AN EXAMPLE

Ellen Margrethe Basse; professor, dr.jur. Affiliation of AU, Business and Social Sciences

Abstract

The World Commission on Environment and Development highlighted in its Report "Our Common Future" (1987) the need to ensure sustainable development by the laws and other regulatory instruments in the area of energy. Several challenges are, however, decisive for a shift to a new regulatory design, at the EU as well as at the national levels.

This paper will paint a picture of the "regulatory-design" used by the EU in the promotion of renewable energy - with the Renewable Energy Directive (RED) as the key directive. It is related to the question in the call for papers: What are the implications for Directive driven legislation in the area of energy generation and transportation, and adjusting the atmospheric signature of industry and agriculture?

The regulatory design used by the EU rests on resource saving concepts covering both command-and-control regulation and that of framework setting for voluntary actions. Each Member State (MS) is subject to individual, quantitative reduction commitments on economic, social and environmental criteria set out in an annex. They have an obligation to take appropriate measures to ensure the implementation and effective effect of the RED as well as other EU law. The RED is a comprehensive activity-based instrument regulating resource use. It covers all forms of RES-technologies and all types of energy generation. It was adopted on the basis of the EC Treaty's environmental rule (minimum harmonization) as well as on the provisions

on the internal market (total harmonization). The interplay between the RED and several instruments (e.g. the EU ETS Directive, Energy Performance of Buildings Directive, Fuel Quality Directive, Industrial Emissions Directive, Regulation on Common Rules for direct Support Schemes for Farmers, and NATURA-2000 networks directives) is an example of a horizontal coordination. The RED is also ensuring vertical coordination established by the binding sustainability criteria that biofuels and bioliquids must adhere to in order to be counted in as contributing towards the mandatory 10% target. The criterion mentioned includes references to the Ramsar-Convention, the Biodiversity-Convention, the UN-FCCC/Kyoto Protocol and other international instruments. Sustainability characteristics would have to include information on the country of origin of the feedstock.

The MSs have procedural and organizational autonomy. Also the principles of subsidiarity and the shared competences between the EU and the MSs have to be remembered. The legal cultures of the different MSs are diverse - will the described regulatory design be useful at the national level? As part of the fulfillment of their performance, the MSs are allowed to use the cooperation mechanisms established by the RED. Is such an alternative fulfillment relevant at the national level?

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SUSTAINABLE URBAN DEVELOPMENT; THE INTEGRATED APPROACH

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Abstract

Sustainable urban development is an important policy aim at the international, European and national level. One of the goals of sustainable urban development is to minimize urban sprawl in order to limit the environmental effects and the loss of biodiversity outside the urban area. This implicates a concentrated urban development with a focus on the redevelopment of existing urban sites. Concentration of activities in the restricted urban area could lead to an accumulation of environmental problems. Yet sustainable urban planning also means 'a good quality of living' in the cities with room for urban green (open) spaces.

One of the possible tools to achieve sustainable urban development is an integrated approach, inter alia by integrating environmental aspects into urban planning law.

This integrated approach is promoted at the European level, but no specific legislation has been adopted thereon. In Dutch law, integrated approaches have been developed which can contribute to sustainable urban development. Examples are the 'City and Environment approach' and the programmatic approach in the legal framework for air quality. The primary focus of these integrated approaches is to solve the tensions between spatial planning law and environmental quality standards.

In the paper I want to explore the chances of such integrated approaches for the support of sustainable urban planning and the role of plans and programmes therein. I will specifically address the (negative and positive) influences of European environmental legislation (e.g. the Air quality directive and the Noise polluting directive) on these integrated approaches.

FLEXIBILITY IN THE EUROPEAN LEGAL FRAMEWORK ON AIR QUALITY

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Abstract

Improvement of air quality has been and still is one of the most important objectives of the environmental policy of the European Union. The current 6th EAP¹ states that the objective of EU air policy is to attain 'levels of air quality that do not give rise to significant negative impacts on, and risks to human health and the environment.'

As a result, there is a large amount of European measures, mostly directives, aimed at reducing exposure to air pollution, like the Ambient Air Quality Directive², the IPPC Directive³ and the NEC Directive⁴. These directives, notwithstanding the fact that they all pursue the general aim of improving air quality, have different specific objectives and lay down various regimes and instruments to attain these objectives. For instance, the IPPC directive aims at an integrated approach to pollution control⁵ and introduces a permit for installations, which should include emission limit values based on the best available technique⁶. A total different approach is adopted by the NEC Directive the aim of which is to limit emissions of acidifying and eutrophying pollutants and ozone precursors in order to improve the protection of the environment and human health against risks of adverse effects from acidification, soil eutrophication and groundlevel ozone⁷. In order to pursue this objective, the directive lays down emission ceilings for certain pollutants which must be attained by the Member States by 2010 at the latest and it lays down the obligation to draw action plans⁸.

In my paper, I will analyze and compare the legal obligations under the aforementioned directives. In this analysis,

special attention will be paid to the freedom or flexibility MS have in implementing these obligations, since this flexibility is an important factor for the actual impact that these obligations could have on air quality. In this respect, one has to think of time extensions for deadlines, the possibility for lowering standards or the freedom to decide in which manner certain objectives like environmental quality objectives are set. Ultimately, it will be evaluated whether these directives are, considering the flexibility, actually capable to contribute to the environmental protection they seek to provide.

¹ COM (2001)31 final.

² Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, OJ L 152, 11-6-2008, p. 1-44.

³ Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on industrial emissions (integrated pollution prevention and control). (Recast), OJ L 334, 17-12-2010, p. 17-119.

⁴ Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants, OJ L 309, 22-11-2001, p. 22-30.

⁵ Art. 1 IPPC Directive.

⁶ Art. 9 (3) and (4) IPPC Directive.

⁷ Art. 1 NEC Directive.

⁸ Art. 6 NEC Directive.

INTEGRATED **ASSESSMENT** OF THE IMPACT OF AQUEOUS **CONTAMINANT STRESSORS** ON SURFACE WATER ECOSYSTEMS

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Abstract

Release of chemicals, either by accidental spillage (e.g. xenobiotics) or direct application/release (e.g. pesticides, micropollutants), is recognized as a significant threat to water resources worldwide. However, little is known about the impact of groundwater contamination on surface water ecosystems. Traditional approaches for managing aquatic resources have often failed to account for the potential effects of anthropogenic disturbances on biota. To fulfil the requirements of the EU Water Framework Directive will be challenging, as it is difficult to successfully separate and evaluate all pressures stressing an ecosystem. Here, methods for determining ecological status in streams are evaluated to see if they are capable of capturing the effects of stressors potentially affecting ecosystems. Specifically, they are tested on a case study where the effects of physical habitat degradation can be ruled out as a stressor on stream ecological conditions (Rasmussen et al., 2011).

This study follows earlier work conducted on a Danish case study involving a TCE groundwater plume discharging into a small stream, located in an area with protected drinking water interests (McKnight et al., 2010). In that study, an integrated modelling approach explicitly linked the contaminant source in groundwater to both surface water and ecological impacts. The purpose of this study is to: (1) compare two modelling approaches; (2) extend the model for additional xenobiotics, pesticides and micropollutants to generalise the findings in the case study; (3) compare two sampling-based indices, i.e. the SPECies At Risk (Liess et al., 2008) and Danish Stream Fauna Index (Miljøstyrelsen, 1998). Both indices are linked to the EU water quality class system and applied to the results of an extensive field campaign carried out in summer 2010. The campaign included an analysis of xenobiotics in surface water, inorganic chemistry, diffuse source (run-off) impacts and ecology along a gradient of contamination in the stream.

and 4-nonylphenol could adversely impact ecosystems at expected environmentally-relevant concentrations. In general, thresholds determined for all compounds in the study were within the source mass discharge ranges expected at sites where contaminants may leach into groundwater (ITRC, 2010). Results of a sensitivity analysis revealed (low) oxygen content, as well as hydro-morphological changes to the stream channel (i.e. percent riffle-run-pool, channel type) to be dominant controls affecting the modelled stream ecosystem. In addition, the field study indicates that the Danish Stream Fauna Index, currently used in Denmark for evaluating ecological status in streams, is not capable of capturing the effects of non-nutrient stressors on benthic macroinvertebrates.

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Modelling results indicate that naphthalene, glyphosate

ENVIRONMENTAL POLITICS AND THE NEED FOR RECONCILIATION: THE CASE OF THE WATER FRAMEWORK DIRECTIVE AND THE RENEWABLE ENERGY DIRECTIVE

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Abstract

The European Union and its Member States rely on a vast range of legislations covering the main policy areas. Over the last 30 years, the extent and the intensity of legislation-making have increased exponentially, especially in the Environmental arena.

Although this abundance of legal instruments represents a certainty of tutelage of EU citizens, it has raised concerns on issues such as the effective implementation of the EU legislation and the incompatibility of certain EU directives' provisions with other Community provisions. Therefore, it is important to discuss upon the conflicts that can rise between the objectives of two or more EU legal frameworks, as in the case of the Water Framework Directive and Renewable Energy Directive.

Despite the fact both Directives aim at the general objective of improving environmental quality through the protection and restoration of water bodies and through the production of renewable energy, the specific objectives might become contradictory. This is the case of the exploitation of certain renewable alternatives, such as hydro-power, when such activity has been found responsible for generating stress on natural resources. On the other hand, requirements considered necessary to protect water courses, might negatively affect the production of renewable energy, thus the potential of certain climate change mitigation measures. Surely, this kind of conflict is one of the main factors generating and increasing policy uncertainty which in turn, affects national policies and their implementation, and last but not least energy companies.

It becomes more and more striking that the objectives of directives can conflict and there is a need of a well balanced approach of EU policies in order to meet both climate and water protection objectives, and there is an urgency to integrate and implement environmental concerns into sectoral policies at both EU, national and regional level.

The purpose of my research is to understand the conflicts and synergies between the goals behind the WFD and RES Directive, how we can reconcile these objectives, and investigate the challenges that governments, industry and researchers are facing when trying to implement these Europe-wide goals at national and regional scales.

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ASSESSING **ECO-HYDROLOGICAL** IMPACTS OF **TEMPERATURE CHANGES** AT THE CATCHMENT SCALE

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Abstract

The sensitivity of fish populations to stream temperature changes is of major concern in many river basins. Silver Creek, Idaho is a spring-fed stream highly valued for its abundance of trout species. The aquifer system that recharges Silver Creek is located in a semi-desert mountain valley. This aquifer is under stress from increasing population and irrigation. Along with changes in morphology and possible climate changes these stresses have led to changes in the hydrologic and temperature regime of the Silver Creek Basin. In particular, higher temperatures and decreased flows in Silver Creek during the summer are threatening the aquatic habitat. A spatially distributed and integrated surface water, groundwater and temperature model of the Silver Creek Basin was developed in order to quantify the changes of these processes under different conditions. The model includes natural and anthropogenic hydrologic processes, surface heat balance components and movement of heat by advection-conduction.

Measures of the ecological impact on trout can be evaluated by using a bioenergetics-based model that links temperature effects to trout growth. Growth rate is a good measure of fish health because it links temperature to other bio-energetic processes such as food consumption and metabolism. Optimal growth occurs at specific range of temperatures, which vary among different species of fish. The integrated tool will allow the evaluation of several management strategies at the catchment scale in order to find an optimal set of solutions for ecosystem status traded-off against other priorities of the basin. Initial results have shown that agricultural practices in the basin are critical in controlling flows to Silver Creek. Model runs representing stream restoration such as deeper channel profiles, showed reductions in the water temperature peaks and oscillations up to 10 degrees Celsius, approximating the range of optimal temperatures for trout.

RESPONSES IN **PLANT** COMMUNITIES TO EXTREME **PRECIPITATION** EVENTS

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Abstract

Global climate change is expected to increase both the frequency and the intensity of climate extremes and there is a need to understand the ecological consequences of such changes. This study aims to assess the effects of heavy precipitation events on terrestrial plant ecosystems.

Responses to variation in precipitation patterns are described by analyzing vegetation data recovered from grassland sites that undergo cycles of experimental flooding to imitate heavy rainfall events. To describe the plant community dynamics during the growing season, pin point data (measures of plant species cover and vertical density) are recorded in May and August. A state-space

model quantifies the competition effect of species (or groupings of species) on each other along the hydrological gradient. Groups are defined by life span and traits such as specific leaf area, seed size and height, which are all likely to reflect adaptation to the hydrological regime. Eventually results from the above can be applied to other sites around Denmark that have vegetation, topography and flooding regimes similar to those of the study sites. The vegetation data from these sites can be obtained from the National Monitoring and Assessment Programme for the Aquatic and Terrestrial Environments (NOVANA), and this will enable us to assess the effects of variation in precipitation in a larger part of Denmark.

STATE-SPACE MODELING INDICATES RAPID INVASION OF AN **ALIEN SHRUB** IN COASTAL DUNES

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Background

Changes in climate and land use affect terrestrial ecosystems. One key component are altered successional pathways including establishment of invasive plant species. Invasion by alien plants has negative effects, for example in European dunes, where Japanese Rosa (*Rosa rugosa*) is reducing local biodiversity. Monitoring local spread of this species depends on long-term data with sufficient spatial resolution.

Methods

Bayesian state-space model are a new method for moni-

toring invasive plants based on unbalanced permanent-plot data. The method allows separation of process and sampling variance, thus enabling ecological predictions with a known degree of uncertainty. The method is applied for in Danish fixed dunes

Results

The probability of observing increased significantly from 0.18 to 0.28 during the period 2004–2007. The species was found in all Danish coastal regions, albeit slightly less common in northern Denmark.

PLANT COVER MODELLING

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Abstract

Background

C. vulgaris is commonly found at Danish dune heaths. Pin-point cover data of *C. vulgaris* was fitted to the measured levels of pH and the ratio between soil carbon and soil nitrogen (C/N). The data fitted the model $f(C/N, pH, C/N \cdot pH)$ with 20% of the variance explained, which is acceptable considering the high degree of variation in pin-point cover data.

Results

Positive synergy effect of high C/N and high pH ($P = 2\%$)
Threshold values of C/N and pH are independent ($P = 20\%$)

In order to model plant cover data it is advantageous to have a model that describes the stochastic process underlying the distribution of plant species:

- large-scale process: extinction/colonisation – plant species do not occur everywhere possible
- small-scale process: size of plants, density-dependent population growth and inter-specific competition

Number of hits will be positively correlated and there will be too many zero values compared to the binomial distribution. Consequently, the zero-inflated generalised binomial distribution is used to describe the distribution of pin-point cover data.

IMPACT ANALYSIS OF MAGNESIUM SLAG DEPOSIT IN CHANGING CLIMATE CONDITIONS

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Abstract

The impact of the airborne pollution by the slag from magnesium production is analyzed in different climate conditions, and the system of its usage as a construction material is proposed. The characterization of the slag is made by using X-ray diffraction, Scanning Electron Microscopy, Differential Thermal Analysis and Atomic Absorption Analysis. The dominant phase is modification of dicalcium silicate (-2CaO SiO_2), formed by polymorph modification from -2CaO SiO_2 during the cooling of non-hydrated slag, significant amount of MgO , gellenite $-2\text{CaO Al}_2\text{O}_3 \text{SiO}_2$, akermanite $-2\text{CaO MgO } 2\text{SiO}_2$ and portlandite Ca(OH)_2 . Granulometric composition of the slag is within the range of $100 \text{ 0/0} - 0,090 \times 10^{-3}\text{m}$. Ad hock measurements on site in June showed that at 100, 300 and 600 m distance from the slag deposit, dust con-

centrations were 1.96 mg/m^3 , 1.73 mg/m^3 and 1.37 mg/m^3 , respectively for North-East direction. By involving the results of experimental investigation of the dust emission for the wind velocities of 5, 7, and 10 m/s, and within the range of relative humidity from 20-50 % into SCREENWIEV software, the obtained values on the diagram showed good agreement with measurements on site. The simulation, that considered the landscape and wind roses in 20 years period, showed that the dust concentration will be over the Maximum Allowed Concentration up to 1400 m from the deposit, for average wind speed of 3.4 m/s, and up to 4000 m at unstable weather conditions. Proposed usage of magnesium slag in mortars is proven by the mechanical investigation of the produced mortars.

SETTING UP NITRATES VULNERABLE ZONES IN ROMANIA

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Abstract

The first analysis for establishing the zones vulnerable of potentially vulnerable to nitrates pollution has been made in 2003 by National Institute for Pedology and Agrochemistry and by National Waters Administration according with Romanian Government Directive 964/2000 regarding the „National Plan for Action of water protection against nitrate pollution originating from farm activity” that comply with European Council Directive 91/676 EEC.

With this first analysis there were found 255 places from Romania that are vulnerable to nitrate pollution that represents 8.64% of country land and 13.93% of nation arable land. They were established taking account the natural soil conditions, climate and water features related with nitrate transfer toward underground waters and creeks on the basis of nitrogen balance in farms, villages or towns, according with European nomenclature (NUTS 5).

There were identified three types of vulnerable zones:

- potentially vulnerable zones: the nitrates transfer conditions toward water bodies are favourable but there is a positive balance of nitrogen at village scale and the nitrates concentration from underground water is under 50 mg/liter;
- vulnerable zones by actual sources: the nitrates transfer conditions toward water bodies are favourable and there is a positive balance of nitrogen at locality scale;
- vulnerable zones from old sources: the nitrate transfer conditions toward water bodies are favourable but there is not a positive balance of nitrogen at locality scale, previously there were animal farms on the surface and the nitrates concentration from underground water is higher than 50 mg/liter.

In 2008 there was made another analysis and there were reassessed vulnerable zones to nitrate pollution on the basis of former evaluation from 2003 that found potentially vulnerable and vulnerable zones. This way, there were established 42 zones that are vulnerable to nitrate pollution in function of the similarities of natural and social economic conditions.

There was elaborated a guide of good farming practices for these zones in order to alleviate nitrate pollution.

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INDICATORS IN THE SCIENCE-POLICY INTERFACE – ARE THEY INFLUENTIAL?

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Abstract

Indicators and indicator sets are increasingly being supplied for communicating evidence to policy processes and to the broader public. The EU FP7 project POINT (Policy Influence of Indicators) aimed to explore the roles that indicators play in different policy processes and contexts, and some of the factors that may be critical for the indicators to be influential in these processes.

The demand for and supply of indicators for environmental and sustainability policies have increased during the last decades. Main drivers behind this trend is adherence to the evidence-based approach to policy making, and indicators viewed as a “knowledge technology” aiming to transfer scientific evidence of wider representation targets to policy makers in an easy-to-interpret manner. Indicators are thought to help highlighting problems, identifying trends, and contributing to the policy formulation and evaluation and monitoring of policy performance. A number of studies however, question to which extent indicators are actually used - and when used, if they are influential on policy processes and outcomes (Gudmundsson 2009, Turnhout 2007).

Results across the POINT project clearly illustrate how indicators are present in a variety of contexts, for a variety of purposes but only sometimes responding to a specific demand. It seems as if the distinction between use and influence of indicators is conducive to the understanding of indicator roles. Use is not exclusively confined to the ‘indicator business’ (producers, institutional users producing texts, evaluation material, decision support documents, etc.) but this community dominates in the user categories found in POINT. The need to transgress this – sometimes overlapping – proximate user and producer group, and to

develop and plan for more inclusive processes of indicator selection and assessment, involving broader groups of end-user seems to be of importance to the influence of indicators. This is the case for the instrumental purposes, but also, and maybe even more importantly, for the development of a learning policy environment.

In relation to the indicator settings where policy monitoring, assessment and evaluation are main objectives, one factor of importance to influence stands out across several studies, namely the existence and political weight of a policy plan with binding goals or objectives, and which addresses issues that are sufficiently high on the policy agenda to warrant policy makers’ attention in case of non-compliance. While evidence of (instrumental) influence found in POINT is generally poor (but existing), some explanations regarding time, clarity of objectives, maturity, institutionalisation and financial back-up are at stake.

It should be noticed, however, that a favourable situation vis-à-vis these factors may open up a role for indicators and indicator frameworks as aversive towards new evidence – supporting a ‘tunnel vision’ and depressing new evidence and ‘best practises’.

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A MAPPING AND MONITORING PROGRAMME SUPPORTING THE NATURA-2000 MANAGEMENT PLANS

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Abstract

Scientists, administrators and managers have developed a Danish mapping and monitoring system for species and habitats over the past eight years. Across the programs a common core set of identical indicators are used. Data on species abundance, species composition, vegetation structure, tree and scrub cover, hydrology and current landscape management of the surveyed habitats are thus available across the monitoring programs allowing comparative analysis of data. High quality geo-referenced field data are continuously collected and stored in a central, and publicly available national database, www.naturdata.dk, providing a solid foundation for decision making and landscape management by the Danish authorities. The data are also available for research groups and students as well as the public in general. However, interpretation of the datasets is complex and often requires expert knowledge, and to support proper decision making in governmental agencies and authorities, Aarhus University and the Danish Ministry of the Environment have developed an assessment system to be used in the NATURA-2000 nature management plans. The home-

page <http://prior.dmu.dk> shows maps with an intuitive and quick overview of the biological conditions in the mapped NATURA-2000 areas. Based on biological and structural indexes the nature management requirements can be deployed for the specific areas. This knowledge can easily be transformed to general as well as specific recommendations in the national and regional NATURA-2000 management plans.

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FOUNDATION OF **SYNECOCULTURE**: TOWARD AN AGRICULTURE OF **SYNTHETIC** AND **PROFITABLE** ECOSYSTEMS

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Abstract

We introduce a novel system of agriculture based on the synthesis of ecosystems, namely "synecoculture", mainly for the culture of vegetables and fruits. The synecoculture consists of associating plants according to their symbiotic interactions with soil, environment, and other vegetation, which augment the biodiversity of the culture beyond natural state.

In such system, thinning harvest from mixed and dense vegetation is shown to be effective for both year-round harvest and weed control.

We report an experiment of synecoculture in Japan without soil cultivation, fertilizer, nor pesticide/herbicide.

The results strongly imply the multifaceted possibility of synecoculture that are more ecological and profitable than conventional modern agriculture.

Keywords: High-density polyculture, thinning harvest, non-cultivation, non-fertilizer, chemical-free, relationalism

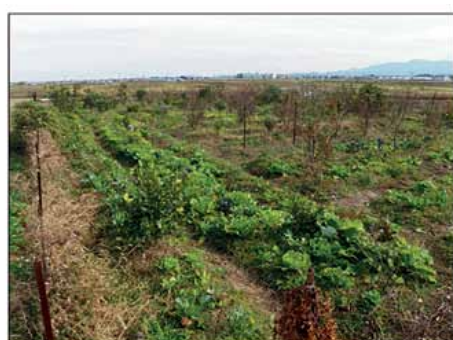
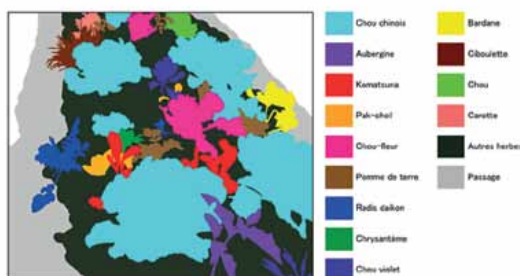
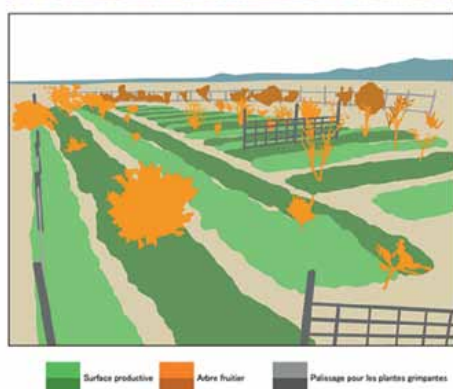


Figure
Experimental field of
synecoculture at Ise, Japan.
Left: Whole view.
Right: Close up of produc-
tive surface.



LAND USE ON HUMIC SOILS – DIFFERENT OUTCOMES

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Abstract

In the Danish landscape low-lying areas on humic soil may be of different type – both on a large and on a small scale. Some areas are nature areas with fens, meadows or pastures and may be sites of high biodiversity. A lot of these areas are not managed any longer, and the consequence is a decrease in biodiversity. Some of the abandoned areas may be affected by former times input of fertilizer and is now dominated by a eutrophic vegetation. Other areas are managed with crop in yearly rotation or as 'permanent' grassland, which may be ploughed but are grown with grass in five years or more. In Denmark there is a political plan for the period 2010-2015 to change 13,000 ha of this mosaic landscape into areas for cleaning the surface water from agricultural land, i.e. sedimentation of P and denitrification of NO₃ in new swamps (a). These 13,000 ha are also called 'new nature'. This poster discusses the

following topics: 1) What do we lose? Nature quality. 2) What are the risks? CH₄ and N₂O emission and P outwash. 3) What is the sustainability? Loss of energy and NPK fertilizer. 4) What do we get? Eutrophic swamps for common species and possible pest species. The poster similarly discusses another possibility on low-lying humic soil, i.e. harvest of biomass of naturally occurring grass and herbs for biogas and afterwards of greater areas securing a better management of semi-natural grasslands, C accumulation, and harvest of nutrient and energy.

Reference

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GENERAL NATIONAL **DOWNWARD TREND** IN THE **NITRATE** CONCENTRATIONS OF DANISH **GROUNDWATER** SINCE 1980

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Abstract

This presentation assesses the long-term development in the oxic groundwater nitrate concentration and nitrogen (N) loss due to intensive farming in Denmark.

Firstly, up to 20-year time-series from the national groundwater monitoring network enable a statistically systematic analysis of distribution, trends and trend reversals in the groundwater nitrate concentration.

Secondly, knowledge about the N surplus in Danish agriculture since 1950 is used as an indicator of the potential loss of N.

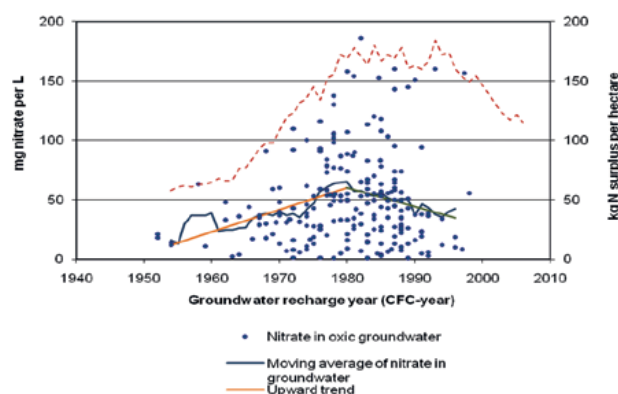
Thirdly, groundwater recharge CFC (Chlorofluorocarbon) age determination allows linking of the first two dataset.

The development in the nitrate concentration of oxic groundwater clearly mirrors the development in the national agricultural N surplus, and a corresponding trend reversal is found in groundwater (see Figure). Regulation and technical improvements in the intensive farming in Denmark have succeeded in decreasing the N surplus by 40% since the mid 1980s while at the same time maintain-

ing crop yields and increasing the animal production of especially pigs. Trend analyses prove that the youngest (0-15 years old) oxic groundwater shows more pronounced significant downward nitrate trends (44%) than the oldest (25-50 years old) oxic groundwater (9%). This amounts to clear evidence of the effect of reduced nitrate leaching on groundwater nitrate concentrations in Denmark. But are the Danish groundwater nitrate concentrations now appropriate according to the Water Framework Directive?

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CAN **CITIZEN SCIENCE** IMPROVE OR SUBSTITUTE A **NATIONAL PROGRAMME**, MONITORING SPECIES INCLUDED IN THE **EEC HABITATS DIRECTIVE**?

Thomas Eske Holm, Bjarne Søgaard & Poul Nygaard Andersen; Department of Bioscience, Aarhus University, Denmark

Denmark has initiated systematic monitoring of species included in Annex II and Annex IV of the Habitats Directive through the launch of the National Nature programme (NOVANA). The monitoring programme primarily monitors population size and distribution in order to provide the scientific background to assess conservation status for each species. The same species are simultaneously monitored in a Danish web-based citizen science project (www.naturbasen.dk) where data are collected randomly, i.e. no methods of data collection are designed and the 15,000 volunteers decide individually what to report. The existence of these two monitoring data sets poses the question whether the citizen science project can improve or partly substitute the National monitoring programme.

We have verified that the citizen science project can supplement the National monitoring programme and improve our knowledge about species distribution (Søgaard & Asferg 2009; Søgaard et al. 2010). New analyses show additionally, that species like dragon flies and other "popular" and easy to recognise species are actually better

covered by citizen science, looking solely on distribution data, whereas the diminutive vertigo snails, floating water-plantain (*Luronium natans*), the submerged Slender naiad (*Najas flexilis*) and similar partly inaccessible species are best covered by the National monitoring programme.

We conclude, that by combining these two data sets we can improve and strengthen the monitoring effort in the National nature monitoring programme concerning the distribution of species suitable for citizen science.

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IS THERE A **MATERIAL KUZNETS** CURVE FOR **ALUMINIUM**? EVIDENCE FROM RICH COUNTRIES

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Abstract

The paper tests the Material Kuznets Curve (MKC) hypothesis with regard to aluminium consumption for 20 high-income countries over the period 1970 to 2009. The test is based on the suggestion of Narayan and Narayan (2010). Various panel data unit root and cointegration tests are applied. The aluminium and GDP series are integrated of order one and cointegrated after controlling for cross-sectional dependence. Moreover, the Blundell-Bond system generalized methods-of-moments (GMM) is employed to conduct a panel causality test in a vector error-correction mechanism (VECM) setting. Unidirectional causality running from real per capita GDP to the

aluminium intensity is uncovered in both the short-run and long-run. The MKC hypothesis is found to hold at individual levels for Australia, Austria, Canada, Denmark, Finland, Greece, Italy, Japan, and United Kingdom as well as for the whole panel. A 1 per cent increase in GDP generates an increase of 0.79 per cent in metal intensity in the short-run and a fall of 0.82 per cent in the long-run for the panel.

Keywords

Material Kuznets Curve, cross-sectional dependence, system GMM, panel DOLS.
JEL: C33, O40, Q54.

LINKING WFD RIVER BASIN MANAGEMENT PLANNING AND CLIMATE CHANGE CHALLENGES

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Abstract

For the 2nd and 3rd river basin management cycles (2015-2027) of the Water Framework Directive (WFD), EU Member States have to fully integrate climate change into the process of river basin management planning. The challenge of WFD planning within the climate change context is two-fold, both adaptation to climate change impacts and mitigation of climate change through possible adverse effects of WFD implementation measures on greenhouse gas (GHG) emissions. Complying with the main WFD objective of achieving 'good status' in all water bodies requires programmes of measures (PoMs) to control nutrient loading to surface waters from point and diffuse sources. A case study of the Isefjord and Roskilde Fjord River Basin in Denmark is used to investigate practical approaches and measures to support the incorporation of climate change adaptation and mitigation in river basin management planning; including the use of a GIS-based decision support system (DSS) to assess the effectiveness and cost-effectiveness of alternative PoMs. There appears to be a large potential, especially within agriculture, for synergies between reduction of nutrient losses and climate change mitigation, among these measures related to manure technology, land use change and energy crops. In order to reach the full potential of this kind of win-win solutions in a WFD perspective a targeted and differentiated approach to the development of action programmes is believed to be necessary.

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DISTINGUISHING BETWEEN **INDIVIDUAL** AND **COLLECTIVE** FORMS OF EFFICACY AND OUT-COME EXPECTATIONS FOR **RISK MITIGATION** IN LARGE-SCALE **COLLECTIVE PROBLEMS**

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Abstract

Unsustainable behaviours at individual and collective scales are leading to changes in the conditions of the Earth, including climate change. Despite the acknowledged need for immediate action, and the importance of individual behaviour in meeting collective aims, the UK public currently demonstrates very low engagement with mitigating actions (IPCC 2007; Ockwell, Whitmarsh et al. 2009)). Evidence reveals that efficacy beliefs* function as important determinants of human motivation and action (Bandura 1995). We argue that in problems requiring collective action, efficacy can act at both the individual and collective levels, with respect to both tasks and outcome expectations. We therefore clarify the conceptual distinctions individual and collective efficacy in the context of both individual tasks and outcome expectations. Through an application to recommended individual behaviours, we demonstrate how these distinctions can support us in managing climate change risk by allowing us to identify the specific forms of efficacy that should be targeted in research, science communication and policy.

* Efficacy beliefs refer to an individual's belief that s/he has the ability to carry out a specified action or to achieve a specified goal (e.g. if I believe that I am able to pass an examination, I have high efficacy with respect to this examination).

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	Individual	Collective
Task	Individual Efficacy "Can I do it?"	Collective Efficacy "Can we do it?"
Outcome expectations	Individual Outcome Expectations "Can my task contribute to the collective goal?"	Collective Outcome Expectations "Can we achieve the collective goal by doing this?"

Figure
 The two-by-two matrix of forms of efficacy and outcome expectations that may be high or low in social dilemmas and/or large-scale collective problems.

THE ECOLOGICAL RECOVERY OF COAL GANGUE DUMPS IN ROMANIA

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Abstract

In Romania, the lignite coal is extracted by open cut mining. This kind of mining determines the most aggressive form of land degradation. The soil strata are reversed, the nutrients are leached, the landscape is degraded, etc. The place of former land is taken by gangue heaps with entiantrosoil that is not a proper formed soil.

The entiantrosoils from gangue dumps have totally different physical and chemical features over the nearby soils:

- the reaction is low and moderate alkaline;
- the humus content is very low, under 0.2%, the nutrient supplying degree is extremely low, too.

These features determine the classification of this kind of soil within the fifth quality class (the last), with an evaluation mark of 8-14 points. It spreads over 19,140 ha in Romania.

Taking account of these unfavourable features for plant developing there is absolutely necessary the ecological recovery that consists of the following steps:

- Pedological, agrochemical, biological, land survey and technological studies;
- Technical – mining recovery that consists of: removing and depositing the fertile layer of soil from surface apart from gangue that is deposited separately in function of their characteristics; technological operation, e.g. leveling, road designation, excess water removal facilities; covering this gangue dump by deposited fertile soil.
- Biological recovery that consists of recultivation of crops, trees, shrubs, etc. that are specific vegetation for the area in order to preserve biodiversity and productivity.
- Agricultural recovery by cropping annual and perennial crops, pastures, hayfields, vineyards, orchards, etc.
- Forestry recovery by planting woods.
- Ambiental recovery, including tourism facilities where applicable.

The agricultural recovery assume covering with a layer of fertile soil and applying of organic fertilizer (50 t/ha) and chemical fertilizers (N100P100K100).

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MICRO-SYSTEM FOR HEAVY METAL MEASUREMENT IN WATER

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The Water Framework Directive (WFD), which governs European water policy, has been in place as the main European regulation for the protection of water resources and the water environment since 2000. One of its principal objectives is to achieve good chemical and ecological status and to restore water bodies to a 'good status' by 2015. WFD requires management of water bodies so that the water quality does not affect their ecological services. Chemical status refers to specific pollutants (priority substances or priority hazardous substances) for which environmental quality standards (EQS) are proposed and defined as minimum requirements. Among these priority

substances, the WFD targets four priority metals are cadmium, mercury, nickel and lead.

We present a generic micro-system for the application of European Water Framework Directive: a new measuring chain for heavy metal quantification in water. Our poster will present a micro-system combining modules for processing, sample digestion, extraction and concentration, and electrochemical detection of the four WFD's metals, namely: cadmium, nickel, lead and mercury. Some preliminary results will be presented.

SEMI-NATURAL GRASSLAND IN DENMARK – POLITICAL INSTRUMENTS AIMING FOR NATURE QUALITY

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Although semi-natural grasslands are protected physically by the Nature Protection Law in Denmark, it is not enough to ensure nature quality at the sites. It is necessary with an adequate management, and this management will only be carried out if the farmer chooses to do so. Economic incentives are given for management and the support is higher for grazing than for cutting. However the economic incentives are relatively low and therefore the farmer chooses to manage semi-natural grassland which can also obtain aid per ha from EU. 84 % of the semi-natural grassland obtaining support for management will at the same time obtain support as permanent grassland. It means that more than half of the species have to be "suitable" as forage or cultural species. Another problem

is that the support for management is connected to a specific cutting date and a rule requires a low and dense sward at the end of the season. This rule is to make it easier to make a control. As the farmers are afraid that the sward is not sufficiently low and dense they often trim the grassland and they actually may destroy quite some nature quality at the sites. For the high nature quality swards the incentives are in general too small to make farmers interested in management, and the control system can have a much too heavy impact. Possible improvements are discussed e.g. higher payments for high nature quality, control with a focus on biodiversity, specific management aims adjusted to the locality and a simpler bureaucracy.

THE PROSPECT OF **GLOBAL CLIMATE REGIME**: EFFECTIVE ENFORCEMENTS AND EMPOWERMENT

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Abstract

Since the 1990s, the study of nontraditional security (NTS) concerns about environmental degradation, outbreaks of infectious diseases, illegal migration, various types of transitional crimes and other threats that danger the security of states and society, and the regional and international community at large. It is important in that "security-framing" brings attention to these threats, convey urgency and command resources from the local to the international to address the complex challenges that arise as we face these security challenges. The threats of weapons, mass destruction, and the spread of global disease remind that we are vulnerable to the unstable world. And most important of all, these above threats usually accompany with climate change, resource depletion and species destruction.

The Copenhagen climate summit, held in December 2009, is the most important meeting since Kyoto (the first climate protocol). After two weeks of negotiations in the Danish capital, 192 countries had reached the "Copenhagen Accord." In the accord, developing countries will submit national reports on their emissions pledges under a method "that will ensure that national sovereignty is respected." The accord was notable in that it referred to a collective commitment by developed countries for new and additional resources, including forestry and investments through international institutions, which will approach USD 30 billion (£18.5bn) for the period 2010 - 2012 to help poor countries cope with the impacts of climate change. However, the conference did not achieve a binding agreement for the post-Kyoto period since this 'political accord' was mentioned by the Conferences of the Parties (COPs) of the United Nations Framework Convention on Climate Change (UNFCCC) as there was no consensus. In addition, the upcoming negotiations are now due to report to COP 16 and MOP 6 in Mexico. Barack Obama had thrashed out a "meaningful agreement" with China,

India and South Africa on some of the steps to be taken toward tackling climate change at the Copenhagen summit, but the "historic" step seems "not sufficient" to fight the ravages of climate change. The Copenhagen Accord has been taken no more than a political agreement without legal standing and has been criticized for lacking a legal framework and concrete objectives.

The 'New Institutionalism', initially advocated by James March and Johan Olsen, refers to institutions as rules, thus political institutions define the framework within which politics takes place. Institutions or international organizations are defined as the rules or norms that govern behavior, whether individual or organizational. In that case, to 'govern' actions means to restrain activity by narrowing down possible means and ends. Besides, the strategies of public diplomacy and international broadcasting based on Constructivism to form the persuasive communication could be utilized to target the global citizen's consensus in application to climate issues. What deters a common ground on climate change is that there is still a gap between the views of the developing and developed world. For this reason, this research intends to explore the approach to facilitate an effective regime that balances state interests, disseminates information to monitor states to comply, and guides the negotiations on a feasible treaty.

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DANISH WEEE MANAGEMENT IN THE LIGHT OF THE WEEE AND ROHS DIRECTIVES: A QUANTITATIVE ANALYSIS OF CRITICAL ISSUES

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Abstract

Waste from Electrical and Electronic Equipment (WEEE) is the fastest growing waste fraction in Europe and is classified as hazardous as it may include substances that have adverse effects on human health or cause damage to the environment (UNEP, 2009). The European Community Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE Directive), together with the European Community Directive 2002/95/EC on the Restriction of Hazardous Substances (RoHS Directive) were established respectively to set collection, recycling and recovery targets, and to restrict the use of six hazardous substances in EEE (Ongondo, 2011). The present study analyses and describes the structure and the actors in the WEEE management system in Denmark. Furthermore, the two directives are considered by looking at critical aspects related to their implementation. Two problematic issues are individuated. First, there is a gap between the reporting of produced and collected amounts of WEEE. This is attributable to three factors: unclear reporting obligation for business to business WEEE producers, attic effect, and improper

disposal of WEEE from the consumers. Secondly, despite the restrictions introduced by the RoHS directive, flows of toxic compounds are still significant in WEEE, as can be demonstrated by performing a Substance Flow Analysis (SFA) (Brunner, 2004) on a Danish WEEE treatment facility. This is due to the presence, in the WEEE, of devices constituting an exception to the RoHS directive and of other substances potentially toxic but not included in the RoHS directive. The study presents a quantitative analysis of such shortcomings and provides recommendations for improved WEEE management.

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MICROBIAL LITTER DEGRADATION ACROSS A LAND-USE GRADIENT OF DANISH STREAMS

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Abstract

Stream ecosystems are impacted by numerous anthropogenic stressors, and they remain some of the most impaired ecosystems on earth in terms of species extinction rates. This emphasises the importance of a yet unresolved question – whether these ecosystems are able to maintain their ecological functions. In consequence, it is highly important to address and characterise relations between stream functions and anthropogenic stress. In streams, fungi and bacteria are key organism groups in the decomposition and conversion of riparian plant litter into more palatable food resources for macroinvertebrate shredders and collectors (Bärlocher, 2005).

We measured mass loss in beech leaves (*Fagus sylvatica*) using net bags with mesh size $< 500 \mu\text{m}$ in 14 Danish streams draining catchments that represented a gradient in agricultural activity. In each stream 30 leaf bags were mounted to the stream bed of which half were positioned at sites characterised by low flow and fine particulate substratum and the other half at sites characterised by turbulent flow and coarse substratum. Leaves were submerged in the streams from April to July. Concurrently, water samples were collected during storm flow events using event triggered samplers and analysed for 18 pesticide compounds.

Leaf breakdown coefficients (k) were reduced by a factor 3–8 in streams where fungicides were detected compared to streams where fungicides were not detected. Breakdown coefficients were, furthermore, significantly lower

($P < 0.05$) for leaf packs that were positioned at sites with low flow compared to sites with turbulent flow. Moreover, we calculated summed Toxic Units (TU) for all pesticides in each sample by weighing the toxic contribution of each compound against its toxicity for *Selenastrum capricornutum* (a microbial standard test organism). Of all measured environmental parameters (physical and chemical stream properties, and catchment properties) the TUS.capricornutum was the parameter most strongly correlated to breakdown coefficients ($r = 0.69$, $P < 0.001$).

Our study is the first to evaluate effects of pesticides on microbial litter degradation in the field. The results clearly emphasise the importance of considering microbial litter breakdown as endpoint when evaluating the effects of anthropogenic stressors in streams. Agricultural pesticides could have the potential to alter the entire flux of energy through ecosystems – an effect that is further enhanced when physical conditions in streams are poor. In addition, our study shows that TUS.capricornutum is applicable for predicting effects of agricultural pesticides on microbial communities.

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BIOENERGY PRODUCTION AND FOREST MULTIFUNCTIONALITY: A TRADE-OFF ANALYSIS BASED ON MULTISCALE SPATIAL TOOL

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Abstract

Large scale environmental assessment needs of Decision Support Systems (DSS) able to consider several aspects in an unique framework analysis. The complexity of interaction between ecological, socio-economical and political aspects and a widespread lack of data availability lead to a difficult in bringing together legislation at national and supra-national level with local planning systems. Furthermore, in practice, only with small scale management interventions it is possible to reach a global sustainable development. This loop can be solved through flexible tools able to relate large scale environmental assessment with small scale DSS, useful for local decision makers.

One of the main environmental topics emerged in last years is the importance of renewable energies to realize strategic objectives in term of reduction of carbon dioxide emissions and integration of thermal and electric energy production. In particular, bioenergy from woody sources can lead to an improvement of agricultural land and forest stands in terms of employment and rural area conservation. However the exploitation of this kind of biofuel must take into consideration an in depth analysis of local energy demand/supply ratio, logistical, economical and social variables. In this way it is possible to implement sustainable agro-energy chain and to avoid an impoverishment of natural resources. In addition, the estimation of bioenergy impact on the multifunctionality of a particular environmental system, seems to get a strong importance (Stupak et al., 2010). For instance, in order to consider all above issues, the Directive 2009/28/EC on the promotion of the use of energy from renewable sources provided both a series of targets to be met by 2020 (e.g. the reduction in EU greenhouse gas emissions of at least 20% below 1990's levels) and the introduction of sustainability criteria in biofuel production.

In this framework the present research aims at creating a multiscale spatial model (called MULTIFORENERGIS) based on Geographic Information System (GIS) tools capable to estimate the potential production of bioenergy from forest residues. The model is carried out basing on the introduction of multifunctionality parameters (Verkerk et al., 2011). The forest functions considered in the model are: (i) timber production, (ii) soil and water protection, (iii) biodiversity and

habitat conservation, (iv) touristic-recreational function and (v) fire risk assessment.

The structure of the model is based on sub-models that enable biomass production analysis from large scale to small scale. Large scale analysis is developed using forest yield data, protected areas localisation, geomorphological variables and fire risk maps. An increase of input data (socio-economics and logistics variables) is requested for small scale analysis. For this reason the spatial tool follows a rule that can be defined as a Scale-Complexity Inverse Proportion (S.C.I.P.): larger is the assessment area size and lesser is the model complexity and viceversa. S.C.I.P. approach permits to realize analysis from national or international level to local one, with different degree of details and differentiated by data availability. In this research, MULTIFORENERGIS model was tested from national (Italy) to provincial scale (Province of Trento in north-eastern Italian Alps). Results were aggregated into a S.W.O.T. analysis to highlight the main strengths and weaknesses, as well as the opportunities and threats deriving from the modelling of trade-off between bioenergy production and each forest functions. The models' results can provide an useful instrument to address the management interventions and to support the administrators in decision making process at local scale. Sensitivity analysis and model validation emphasize the possibility of using the model as Decision Support tool in environmental and forest planning. Finally, comparison between model results and real timber production data stressed the level of uncertainty in the evaluation.

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SUSTAINABLE MANAGEMENT OF **DEGRADED ECOSYSTEM** WITH **ENGINEERING INTERVENTIONS** - A SUCCESS STORY

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Abstract

Engineering interventions were taken up for the restoration of the bio diversity of a manmade wetland situated in the shadow of ecologically sensitive & geologically unstable Shivalik foothills forming a part of fragile Himalayan ecosystem. It establishes the linkages of hill denudation with environment and poverty in the Sukhomajri catchment of Sukhna –a 3 sq. km rain fed protected national wetland. The problem of siltation was so acute that several agricultural fields were converted into 20 metre deep and wide gorges from the uncontrolled rainwater coming from the catchment reducing the pondage capacity of wetland by 60%. Commercially sensitive and economically exploitative attitudes of locals subjected this ecosystem to stress, leading to alteration and hampering of its functions and then lead to ultimate destruction. The project drastically reduced silt flow, improved ground water recharge and moisture regime apart from providing food, forage, fuel,

flood and social security. The paper apart from commenting on community based restoration and sustainable management of wetland and critically assessing the performance of engineering interventions also attempts to focus on the ecological principles that are real tangible parameters of sustainability of the wetland habitat.

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CAN **MOWING** AND SHEEP **GRAZING** ON WET HEATH REVERSE THE DECLINE IN THE DENSITY OF **ERICA TETRALIX**?

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Abstract

During the last decades Erica tetralix has experienced a markedly decline in Denmark. The object of this study is to see whether different management tools can reverse this decline. The focus is to improve the competitive conditions for Erica tetralix, to see if competition has an impact on the density of Erica tetralix. The two different management tools studied are mowing and simulated sheep grazing.

These are implemented on the wet heath at Lønborg Heath, where Erica tetralix is in decline. In reference to sheep grazing, Stenbjerg Heath is studied, since it for several years has been affected by sheep grazing. The study also includes an analysis of NOVANA data to see if there is an effect of sheep grazing on a national scale.

SHORT-TERM TRENDS IN VEGETATION COVER OF DANISH SEMI-NATURAL ECOSYSTEMS

– A LANDSCAPE-ECOLOGICAL ASSESSMENT OF MAIN DRIVERS INDICATED BY TRAITS OF WINNER AND LOSER SPECIES

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Abstract

The landscapes in which many plant communities persist today are increasingly modified by anthropogenic activities, especially in Denmark, where most communities are influenced by for example atmospheric deposition of Nitrogen, changes in soil moisture levels (e.g. ground water-table changes caused by drainage) and changes in management regimes (primarily reduced grazing-pressure). Such modifications of the environment are filtering the persistence of species into those that are adapted to these new conditions (winners) and those that are not (losers) (McKinney & Lockwood 1999).

Across the landscape, it is reasonable to expect species with similar traits to respond similarly to systematic shifts in habitat conditions and disturbance. Consequently, contrasting traits of winner and loser species could be a powerful tool in identifying mechanisms that might be driving community changes.

In this study, we use a large dataset of vegetation surveys from 207 semi-natural non-forested sites in Denmark, identifying temporal short-term changes in vegetation cover, notably identifying those species that are winners and losers. A further goal is to identify environmental drivers of contemporary vegetation change in Danish semi-natural habitats by quantifying which functional traits makes species decline or increase. We therefore assess whether winners and losers differ with regard to key functional traits and ecological indicator values, and whether these results match our expectations given the current anthropogenic disturbance regime. Notably, do winner and loser species display distinct sets of traits of the ones related to: exotic species invasion, eutrophication by nitrogen deposition,

management changes (decreasing grazing and associated encroachment by woody plants), soil moisture changes (due to excessive water extraction and drainage)?

Preliminary results suggest that even during a relative short time span of just seven years, it is possible to identify winner and loser species, indicating that significant shifts in species composition are currently taking place in Danish semi-natural ecosystems. The number of identified loser species was greater than the number of identified winner species, suggesting that homogenization of species composition across the landscape may be a concern.

Today, management of semi-natural habitats is a common conservation measure. However, despite traditional management, habitats may still be vulnerable to compositional changes due to e.g. surrounding land-use and atmospheric nitrogen deposition. The preliminary results from this study, are dichotomous in that it seems some factors as for example soil moisture and woody species encroachment are being managed in a way that opposes expectations from human disturbances, whereas management can not combat the effects of nitrogen deposition. Further analyses are still being developed to differentiate the landscape pattern of winners and losers into the specific habitat-types to induce differences between them in their responses to environmental drivers.

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SUSTAINABILITY AND TIME HORIZON

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Abstract

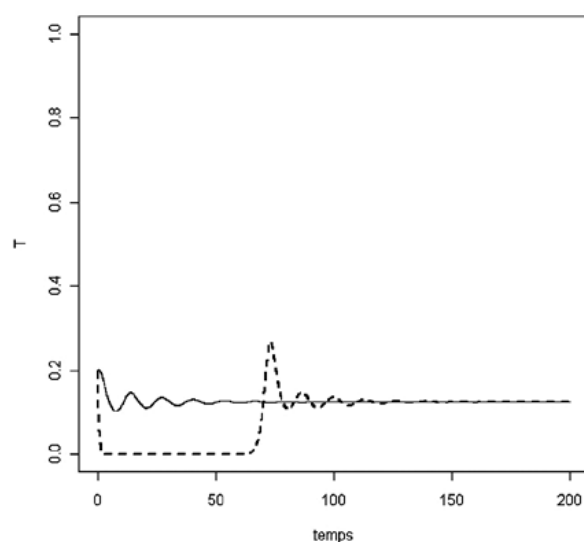
In the case of theoretical studies for the sustainable development, one approach is building a dynamical system to study the problem at hand, and solve the problem by finding a balance or stable area, usually noted attractor. When dynamical models are differential equations, sustainability is often linked with asymptotic properties, and so with bifurcation diagrams. This can be justified by the fact that sustainability urges to think of the needs of future generations. Nevertheless, not being stuck to present time does not mean only considering asymptotic properties and consequently infinite horizon. Two reasons can be suggested: models are not indefinitely valid, and sustainability should not mean forgetting present generations. The time factor is not taken into account in asymptotic studies, although transient dynamic can be prominent for the validity span of the model. For example, in the figure, these

two trajectories tend to the attractor, but the dotted one remains a relatively long time very close to 0. Therefore, we need to find ways to solve these problems.

The viability theory initiated in the early 1990s by Jean-Pierre Aubin [1] and his colleagues focuses on the problem of viability, it concerns controlled dynamical systems for maintain a dynamic system in a set of constraints. This theory appears in economics, cognitive science, game theory, biology, automatic, etc. Thanks to viability theory, we can find a domain that all the point in this domain will remain in constraints infinite time. This is fully consistent with the premise of sustainable development.

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NITROGEN LOADINGS AND CONCENTRATIONS TO **ESTUARIES** IN DENMARK DURING THE PERIOD 1990-2009: REGIONAL DIFFERENCES IN **SOURCES, LOADINGS, SINKS** AND ESTUARINE RESPONSES

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Abstract

Since late 1980'ies a wide range of measures have been taken to reduce land based nitrogen (N) loading of Danish freshwater and coastal waters. On a national scale, the N- loading has been reduced by 47%. The loading figures are derived from monitoring stations in streams covering 50% of the national territory, whereas loadings from the remaining part are estimated using empirical models. The different mitigation measures and the resulting effect for reduction of N loadings will be presented for around 10 paired catchments and estuaries in order to analyse for regional differences in the outcome of the national action plans.. The analysis of N sources, loadings and trends in

flow-weighted concentrations in inlet water to the estuaries shows that there are large regional differences caused by different anthropogenic and natural processes. Trends in nitrogen concentrations in the estuaries are also varying between the estuaries analyzed but shows in general a lower trend than found in inlets waters. The reason for this apparent discrepancy is discussed.

Finally, some major challenges in the Water Framework Directive N reduction targets for the estuaries and the efforts needed for obtaining these reductions in nutrient loading in the years to come are briefly highlighted.

MYTH AND MOMENTUM: AN ASSESSMENT OF ENVIRONMENTAL IMPACT ASSESSMENTS

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Abstract

Environmental impact assessments (EIAs) are designed to document all reasonably foreseeable consequences of proposed actions or activities for environmental resources, such as ecosystems, habitats and species. Traditionally, these assessments have been undertaken directly by management agencies, often involving appropriate government researchers. However, the number of EIAs required is rising. Furthermore, cumulative impact assessments are a challenging, but increasingly important component of broader EIAs. For these and other reasons, many EIAs are now contracted out, often to the lowest bidder, who may or may not have all the relevant expertise immediately available. Other EIAs may still suffer from limited agency resources or structural conflicts of interest. In both cases, EIAs are now often rushed to completion to meet legislative deadlines or avoid delaying projects. The resulting assessments tend to be (although are not always) poorly researched documents that draw heavily upon previous EIAs. Consequently, treatment of topics quickly becomes habitual, perpetuating misconceptions and analytical

flaws from previous documents that may lag substantially behind advancements in the scientific literature. Common misconceptions expressed in EIAs concerning wildlife impacts include: a focus on lethal takes of species and the underplay of non-lethal impacts or habitat degradation; a general dismissal of the possibility that non-significant (to the resource) impacts can combine to become significant; and the assumption that behavioural habituation in animals represents an end of impact. Incentive to break the cycle is lacking in this now commercially competitive business environment, where assessment contracts are increasingly awarded by those intending to undertake the activities. This also generates a potential conflict of interest, where contractors may feel obliged to effectively approve the actions to avoid losing future contracts. However, we believe investment in thorough, impartially written, scientifically-based and up-to-date EIAs is important for appropriately managing a resource and avoiding potentially expensive litigation.



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